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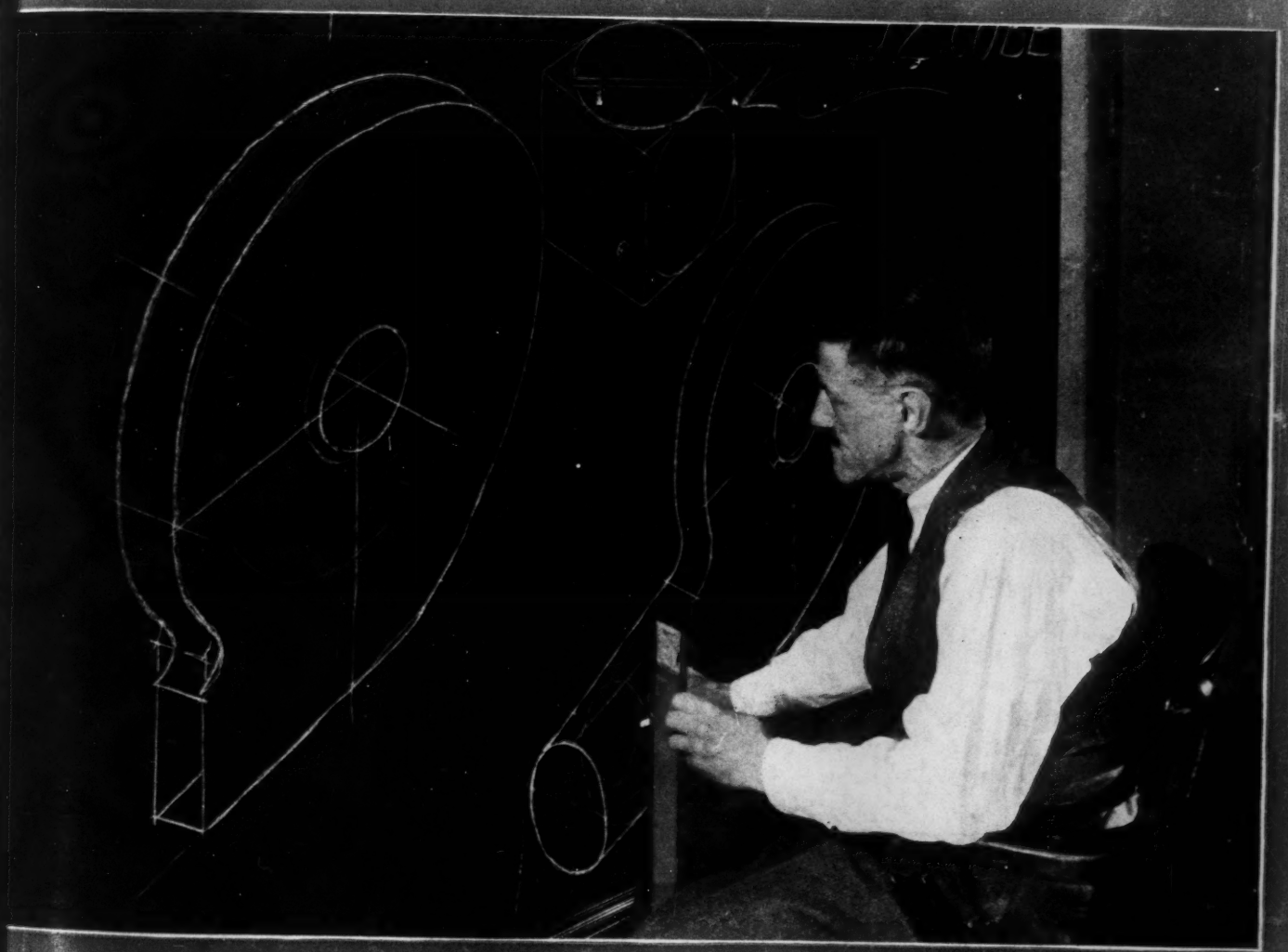
Page 147 — Journal Section of the American Society of Heating and Ventilating Engineers



IN THIS ISSUE: Perspective and Orthographic Drawing . . . The Heat Pump . . . How to Keep Fuel Use at a Minimum . . . Pipe Bends and Flange Alignment . . . Industrial Exhaust Systems . . . many others

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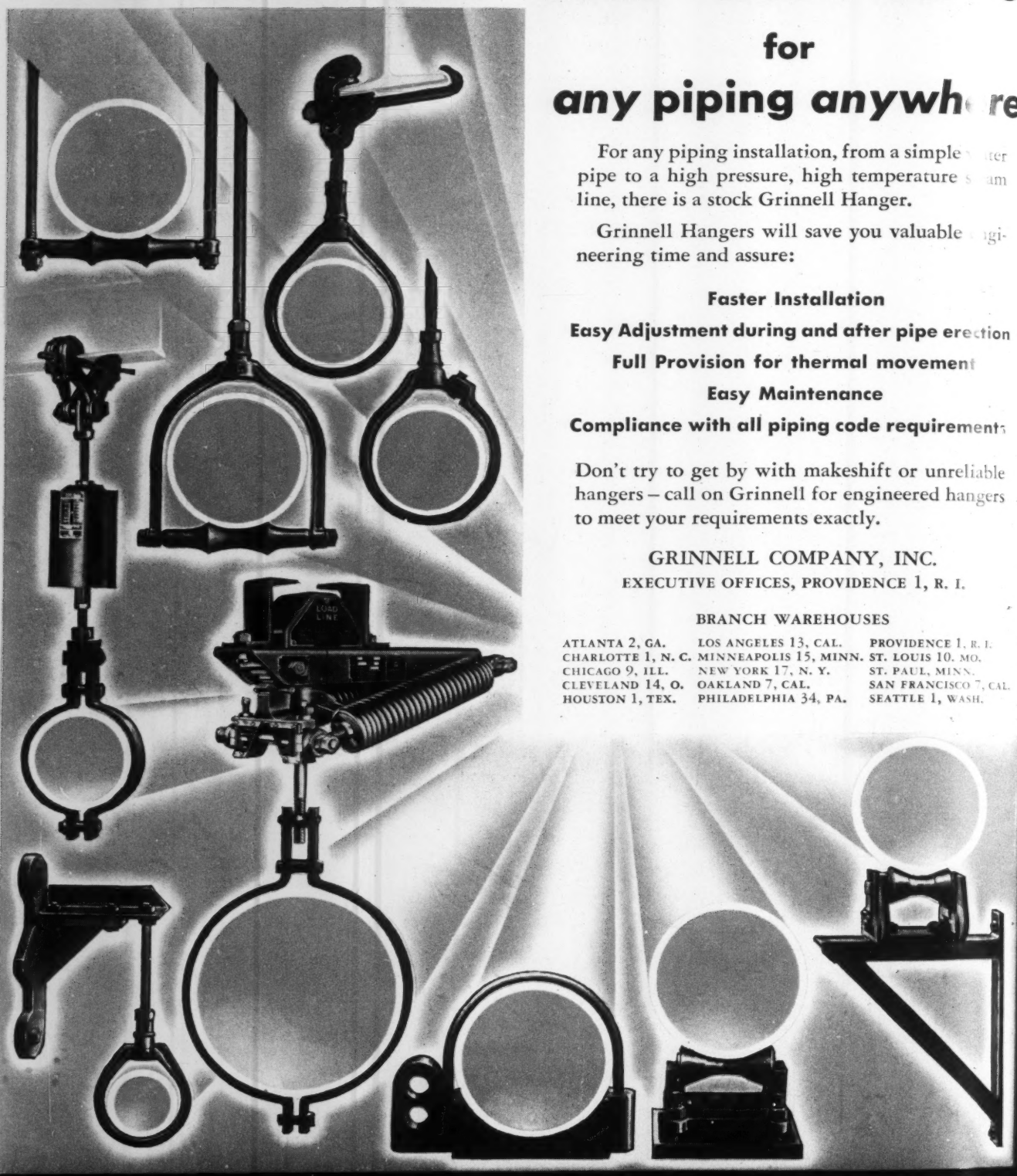

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INTRODUCING A NEW CONTRIBUTING EDITOR

Leo F. ("Doc") Collins, the newest addition to HPAC's board of consulting and contributing editors [see page 69], holds three academic degrees in chemistry and is registered as a professional engineer. During the past 20 years he has devoted most of his time to a study of the chemistry of water conditioning as it relates to steam generation and use.

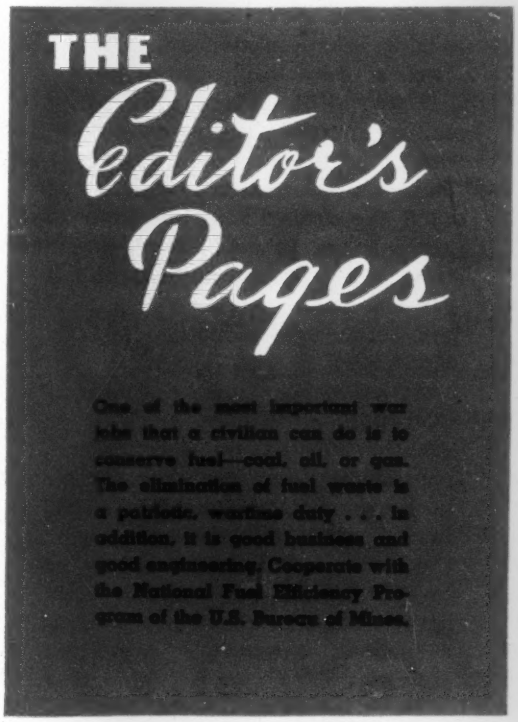
He has supervised the revision of the water processing system in more than 25 steam power plants and has published a large number of technical articles. Readers of HPAC will probably recall his series of articles, in 1939, dealing with corrosion in steam heating systems, and his more recent contributions in the ASHVE Journal Section.

Mr. Collins is chairman of the corrosion committees of both the ASHVE and NDHA, and is an acknowledged authority in his field.

SURVEYS ARMY HOSPITAL AIR CONDITIONING

The military affairs committee of the House of Representatives recently issued a report on its survey of Army hospitals, in which special attention was directed to the care and treatment accorded sick and wounded U. S. soldiers. The study was part of an investigation conducted pursuant to a resolution authorizing this committee and the committee on naval affairs to study the progress of the national war effort. (78th Congress, 2d Session, House Report No. 2092).

In developing the ventilation and air conditioning phase of the investigation, "a considerable lack of uniformity was uncovered," says the report. "Some buildings were found to have fans in wards, others had none. Air cooling systems were generally nonexistent except in some operating and x ray rooms. It seems that for determining whether or not air conditioning is necessary, the War Department has theoretically divided the country into thermal zones which are based upon, and enclosed within, mean high and average low temperatures. An arbitrary thermometric reading is then established, and that determines whether a hospital gets or does not get air conditioning equipment. It is not clear to the committee why maximum temperatures and humidities actually encountered, rather than averages, are not made the determining factors. Forced draft systems, operated by ceiling exhaust systems, are absolute requisites in orthopedic wards regardless of geographic situation, yet many are still denied them."



The committee listed a number of instances "that appeared to warrant attention of the War Department," among them being the following:

"Case 5—Smokestack of adjacent heating plant is so low that smoke and soot seep into and settle in the hospital building.

"Case 12—No air conditioning of any kind in operating rooms; windows must be kept closed even in the hottest weather. It is difficult for surgeon and staff to operate under such conditions. Patients often become so "dehydrated" as to require the administration of intravenous fluids in order to insure recovery.

"Case 14—Operating room has no air conditioning other than that provided by one small window unit which does not provide much relief on extremely hot days.

"Case 16—This hospital lies in the 70 deg thermal zone, which means that under War Department standards it is not entitled to air conditioning notwithstanding the fact that a temperature of 100 deg is often experienced. The operating rooms are then described as unbearable. To make matters even worse, dust storms make it necessary to keep all windows closed tightly.

"Case 28—Lacked air conditioning, even in orthopedic wards, where the sufferings of patients encased in plaster casts are intensified in hot weather, and whose wounds give off acrid odors. On one occasion it was necessary to appeal over the radio for the donation of electric fans by graciously disposed residents in the vicinity. Approximately 172 fans of all descriptions were received."

[Note: Army policy on the installation of air conditioning and ventilation was outlined on pages 584-585 of the October 1944 HPAC.]

$300 MILLION FOR HOTEL REHABILITATION

A program calling for the immediate expenditure of almost $300,000,000 in the rehabilitation of hotels, when men and materials are available after the war, was recently announced by the hotel industry in seeking tax relief from the Treasury Department for this purpose.

"The rehabilitation program," said J. E. Frawley, president of the American Hotel Association, "is necessary because of greatly increased occupancy and wear of hotels during the war, and the inability during the same period to obtain manpower and materials for maintenance work."

It is estimated, said Mr. Frawley, that heating, air conditioning, and ice equipment expenditures will amount to not less than $33,216,916. This is exclusive of any new hotel building that may be under-

THE Editor's Pages

taken in congested areas suffering from a shortage of rooms. It is believed there will be relatively few such areas when conditions return to normal. The hotel industry was substantially overbuilt after the last war, and, as a result, many hotels were forced into bankruptcy. Accordingly, the trend today in the industry is to rehabilitate existing properties by means of extensive refitting, repairs, and maintenance work.

To obtain an up-to-date picture of its needs, the hotel industry, through the AHA, canvassed members in all parts of the country.

The group of large AHA hotels, of 300 rooms and more, covered by the survey, show a planned expenditure of $101,851,854. The group in the 100-299 room category plan expenditures of $133,870,240, while hotels of from 50-99 rooms plan to spend $56,054,160.

Heating, air conditioning, and ice equipment planned in these three categories amount to $13,012,616, $15,910,300,and $4,294,000, respectively.

The average heating, air conditioning, and ice equipment expenditure, per hotel, in the first category (300 and more rooms) is calculated at $39,916; in the second category (100-299 rooms), $13,370; in the third category (50-99 rooms), $2825.

THE TYRANNY OF TEMPERATURE

Despite his elaborate internal temperature-control mechanism, optimum temperature and humidity ranges exist for man, varying somewhat with activity and the type of clothing worn. For light work indoors, it appears that temperatures of from 65 to 70 F and relative humidities of about 60 per cent at the lower temperature and 40 per cent at the higher give the greatest feeling of comfort and the best conditions for efficiency. When sleeping, somewhat lower temperatures are preferable provided some form of covering is used to maintain a temperature of about 80 F next to the skin. The temperature-regulating mechanisms of the body are sufficiently flexible, however, so that in completely dry air indoors, human beings can tolerate temperatures up to 112 F when nude and up to 138 F when clothed. Clothing protects the body not only against cold, but also against heat, as desert dwellers have long known. As the humidity at high temperatures rises and perspiration evaporates more slowly, clothing becomes decreasingly valuable. In saturated air at 88 F the clothed body is unable to prevent its internal temperature from rising above normal, and a genuine fever results. For a nude body, the corresponding limit is about 92 F.

At low temperatures the limit of toleration is vaguer, since it is greatly affected by clothing and physical activity; but when the air inside the clothing becomes too cool, just as when it becomes too warm, the body is so fully employed in the task of keeping its internal temperature constant that there is little surplus of energy for any other activity.

Much effort has gone into the gathering of objective data by which the general level of civilization in various areas may be judged, and while it is easy to overestimate the effect of a given variable, it does seem that a good climate is an important aid, although not a guarantee, for a low average death rate, low infant mortality, and high per capita income. For example, tests of general culture have shown Washington, Oregon, California, New York, Connecticut, and Massachusetts high on the list. Indeed, it has been suggested that development of heating means facilitated the spread of civilization to northern Europe in the Middle Ages. Similarly, modern air conditioning helps to mitigate the situation of the tropics.—*From the Industrial Bulletin of Arthur D. Little, Inc.*

FLOOR HEATING, AIR CONDITIONING FOR COMMONS

The announcement that the design for the heating and ventilating apparatus for the new debating chamber of the House of Commons has been entrusted to Dr. Oscar Faber, president of the IHVE, will interest engineers in all parts of the world, says the Journal of the [British] Institution of Heating and Ventilating Engineers.

Plans for the new chamber have been the subject of a report from a select committee, but they are, of course, still subject to the approval of the House.

The old chamber, which the new one is likely to resemble in many particulars, was destroyed in the mass air raid on London on May 10, 1941.

The ideal atmospheric conditions sought for by the chamber's planners will approximate to those of a warm spring day out-of-doors, the IHVE Journal says, and a special feature will, apparently, be variable air currents calculated to produce, according to the report, "conditions conducive to alertness."

The entire installation is designed to produce "cool heads and warm feet," and not *vice versa*.

The Commons' air volume will be double that necessary to meet the requirements for theaters and the air will be cleaned electrostatically.

Reference to "warm feet" is borne out by the proposed provision of bronze panels under the carpet, warmed to a temperature of 80 F, according to the Journal.

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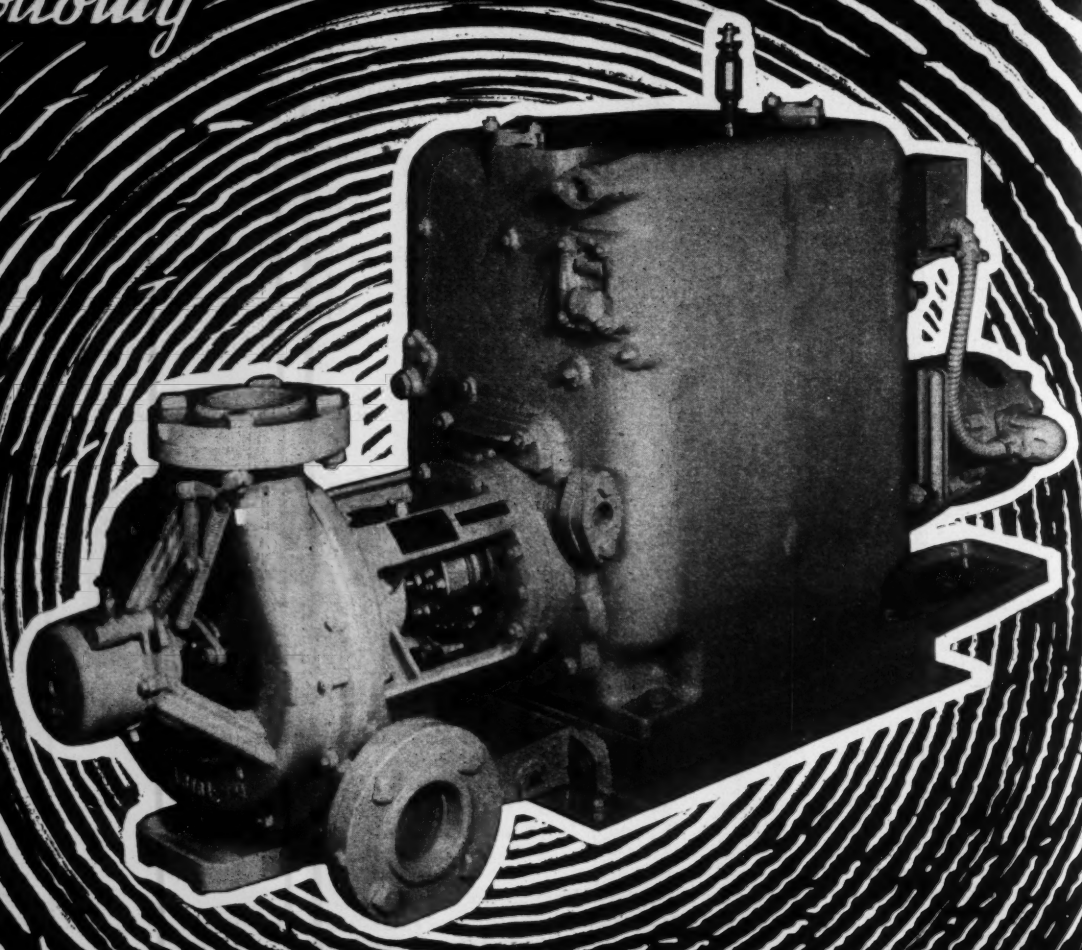
Centralized Heating Economy



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NINETY-THREE YEARS ago Lord Kelvin pointed out the possibilities of heating buildings by means of the heat pump, warming engine, or reversed refrigeration cycle (call it what you will). The purpose of this article is to suggest some of the reasons this method is still largely an academic device, although of course there are a number of more-or-less experimental or demonstration installations. In this clear and concise discussion, the author explains how a heat pump operates in a way that requires no knowledge whatever of thermodynamics to understand, and winds up with some of the reasons why the heat pump will be used and also the reasons it is not being used to the extent visualized by Lord Kelvin 'way back in 1852.

What's Holding Back the HEAT PUMP?

By J. Mack Tucker
Associate Professor
Mechanical Engineering
University of Tennessee

MOST OF us have had the experience of a friend wiring that he was on his way to pay a visit and requesting that we meet him, but neglecting to state the time of his arrival or the mode of transportation. We start scurrying about meeting trains, buses, and planes, and maybe two days later we get a letter from the friend informing us that he still plans to come but that his trip has been delayed for a few weeks.

The dilatory friend who created this social dilemma has a parallel in the field of winter air conditioning in the promising but elusive "heat pump." Lord Kelvin was expecting the "guy" in 1852 when he pointed out the possibilities of heating buildings with a heat pump or warming engine. Thirty years later he noted that the method which he had described remained "unrealized to this day."* But he continued, still having faith in the idea, "when Niagara is set to work for the benefit of North America through electric conductors, it will no doubt be largely employed for the warming of houses over a considerable part of Canada and the United States."

It might be of interest for us to inquire why the tardy visitor has still not arrived after 93 years, and the purpose of this article is to suggest some of the reasons the heat pump is still largely an academic device to plague students in elementary thermodynamics. (I am not unmindful of the several experimental or demonstration installations which have been made in this country and abroad that have shown that the idea can be reduced to practice. In fact, the observations made here are based largely upon data gathered from such installations.)

A look into any textbook on thermodynamics, mechanical engineering handbook, or technical encyclopedia will divulge the essential idea of a heat pump, or it may be listed under an alias such as warming engine, reversed refrigeration cycle, or inverted refrigeration cycle. The look will also divulge a brain-teaser for the uninitiated because it is pointed out that the heat equivalent of 5 kwhr of electrical energy can be supplied to heat a building for each kwhr of energy purchased from the local electrical utility. In other words, five times as much heat can be delivered by the heat pump as would be delivered by direct resistance heating units. Could this be five times as good as perpetual motion? Immediately we get interested in the idea and resolve to take advantage of the utility company's generosity.

All students of elementary physics and thermodynamics are aware that the heat energy supplied by the combustion of fuels to keep

*Mathematical and Physical Papers, Sir William Thomson, vol. 1, 1882.

buildings warm in the winter does not vanish completely. According to the principle that energy can neither be created nor destroyed, it remains in the vicinity, but because of its reduced temperature it is no longer of value for comfort heating purposes. The energy necessary for heating a building is, therefore, already in the environment or neighborhood, but it is at a low temperature level and cannot be used. Then comes the idea that we might be able to use heat energy which the neighbors are throwing away to heat our building. The problem is how to do it.

By this time we are confused—if not exhausted—and we raid the mechanical refrigerator for refreshment. Say, why hadn't we thought of this before? The mechanical refrigerator is taking heat energy from a low temperature level and delivering it to a higher level. This is accomplished in a conventional unit, Fig. 1, as follows: The receiver *E* contains liquid refrigerant, such as sulfur dioxide, methyl chloride, "Freon," or some similar substance with a low boiling point. The liquid refrigerant flows through the expansion valve *F* into the cooling coil *A*, where the pressure is less than that at *E*. Since the pressure in coil *A* is less than in receiver *E*, the boiling temperature in *A* will be considerably below the temperature of the liquid entering valve *F*. The temperature of the refrigerant in the coil will stabilize itself at the boiling point corresponding to this lower pressure. Heat will flow from the food and containers in the refrigerator into the liquid refrigerant, thus removing heat from the refrigerator and in turn causing more liquid refrigerant to evaporate.

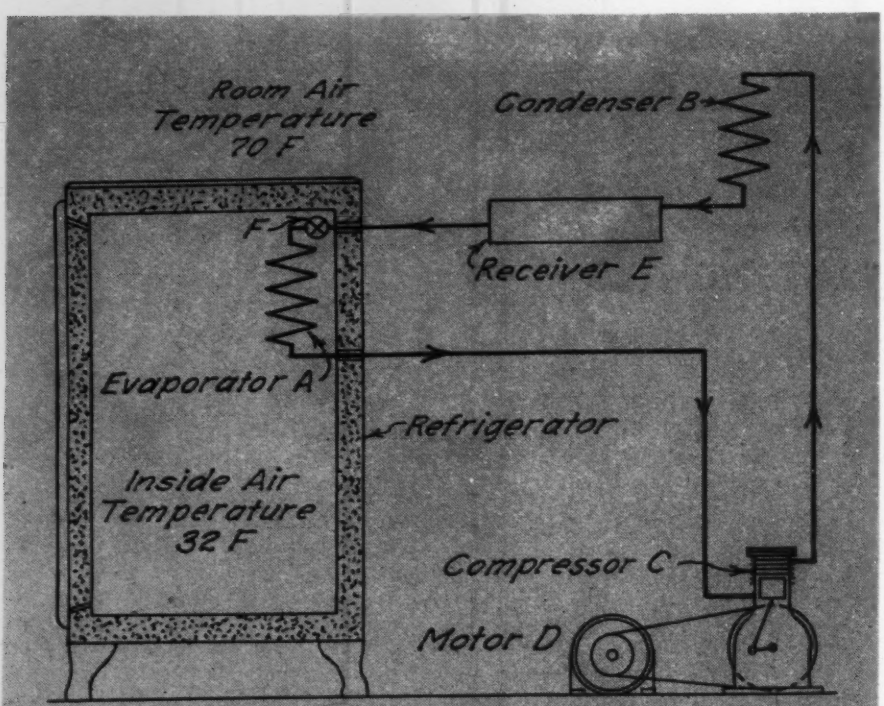


Fig. 1—An ordinary domestic refrigerator takes heat from a low temperature level and delivers it to a higher level

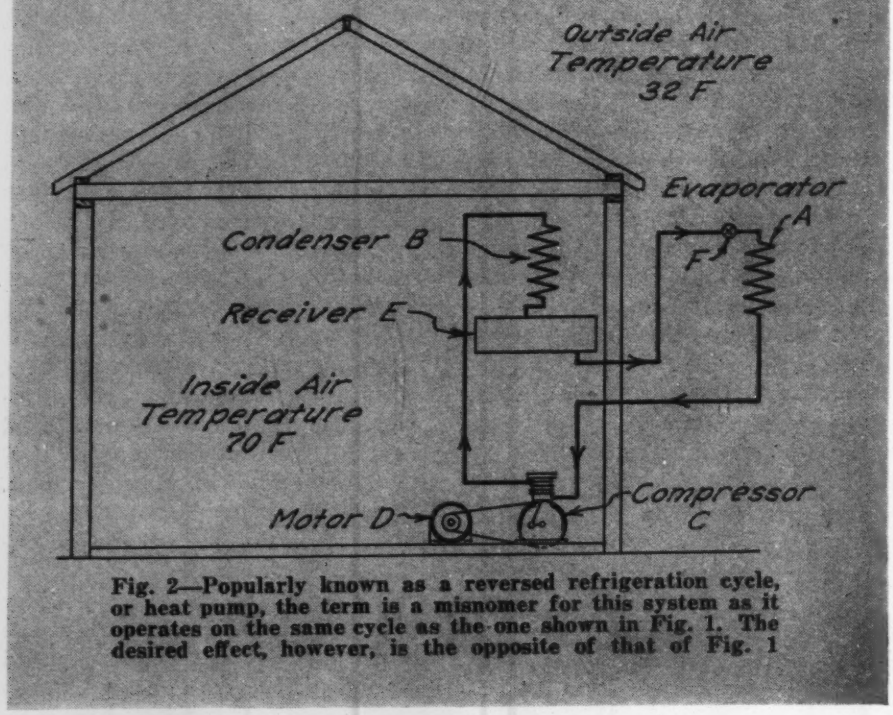


Fig. 2—Popularly known as a reversed refrigeration cycle, or heat pump, the term is a misnomer for this system as it operates on the same cycle as the one shown in Fig. 1. The desired effect, however, is the opposite of that of Fig. 1

The compressor *C* removes the vaporized refrigerant from the evaporator and compresses it to a pressure equal to that in the receiver *E*. During compression the temperature of the vaporized refrigerant is raised to a point higher than 70 F, the temperature of the room air, just as air is heated when compressed by a tire pump. It then passes into the condenser or heat diffuser *B*, where heat will be given up by the refrigerant to the surrounding air. The liberation of heat by the vaporized refrigerant causes it to liquefy and flow into the receiver *E*, where it is ready to start its cycle over again.

Here's What a Heat Pump Is

If we should exchange the positions of the evaporator (the cooling coil) and the condenser (the heat diffuser), and substitute a building for the refrigerator cabinet of Fig. 1, at the same time increasing the size of the equipment proportionately, we would have the setup shown in Fig. 2. Now the cooling coil *A* is outdoors and the heat diffuser *B* is inside the building. If the outside temperature is 32 F and the desired inside air temperature is 70 F, then by operating the system, heat energy will be picked up from the outside at a low temperature and delivered into

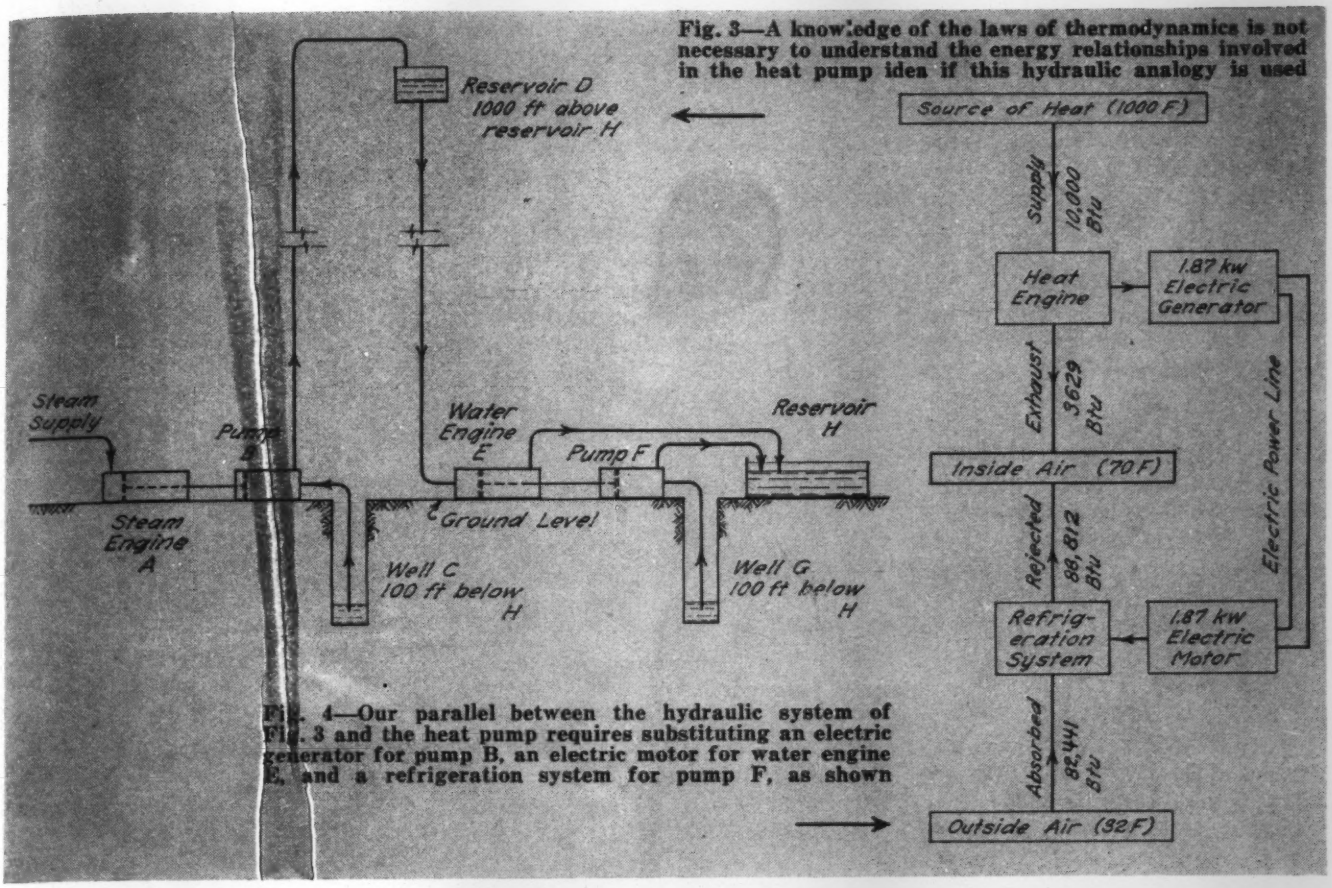


Fig. 3—A knowledge of the laws of thermodynamics is not necessary to understand the energy relationships involved in the heat pump idea if this hydraulic analogy is used

Fig. 4—Our parallel between the hydraulic system of Fig. 3 and the heat pump requires substituting an electric generator for pump B, an electric motor for water engine E, and a refrigeration system for pump F, as shown

the building at a higher temperature. The compressor may now be thought of as a heat pump picking up heat energy at a low temperature level and delivering it to a higher temperature level. The system of Fig. 2 is popularly known as a reversed refrigeration cycle; the term, however, is misleading as a study of the cycle shows that it has not been reversed in any part; it is merely the desired effect that has been reversed in that we now want to save the *heat*, whereas we wanted to "save the *cold*" in the refrigerator.

We agree that the system just described doesn't sound too complicated, but we still aren't sure what happened to the "perpetual motion," or the "something for nothing" idea. A simple hydraulic analogy (which does not require a knowledge of the laws of thermodynamics in order to understand the energy relationships) may be of some help in solving our puzzle. First, referring to Fig. 3, consider only that portion of the system consisting of an elevated reservoir D, a water engine E, a pump F, a well G, and a reservoir H at ground level. If the system were without friction, each pound of water flowing from reservoir D to engine E would produce 1000 ft-lb of kinetic energy. As the water from G to H must rise only 100 ft, we can—with this amount of energy—raise $1000/100 = 10$ lb of water from G to H. The discharge from E can also be delivered to H and we thus end up with 11 lb of water at H for each pound drawn from D. It is evident that increasing the height of D above H will deliver more water to H because of the greater amount of energy available at E. It is also true that a greater amount of water would be delivered to H if the well G were less deep. For example, if D were 2000 feet above H and G were only 10 ft below H, then $(2000/10) + 1 = 201$ lb of water would be delivered to H for each pound drawn from D. Note that it is the elevated reservoir D that provides the energy to operate this effective pumping system.

Unfortunately, nature has provided reservoir D in only a very few locations. Therefore, it is necessary to devise means of maintaining reservoir D if the system is to operate continuously and have universal application. Consider now the left-hand portion of Fig. 3, consisting of a steam engine A, a pump B, and a well C (which could be the same as well G), which will supply water to reservoir D. If we assume this portion of the system to be without friction also, it is evident that as much energy will be required to raise 1 lb of water from the pump B to the reservoir D as was obtained by 1 lb of water flowing from D down to E. An additional amount of energy will be required to raise the water from the well C up to the pump B. That is, for each 1100 ft-lb of energy supplied to pump B by engine A, $10 + 1$ lb of water will be delivered to reservoir H. If the 11 lb of water had all been pumped up from well G to H, 1100 ft-lb of energy would also have been required.

One begins to wonder by now whether or not it would be less expensive to use the steam engine to drive pump F directly and eliminate reservoir D. The pendulum has swung the other way. What we thought at first to be "perpetual motion" now seems a doubtful investment of energy when we note that it is impossible to operate pump B, reservoir D, water engine

E, and the connecting piping without some friction. If the analogy has a moral it certainly is that we pay for everything we get!

Our parallel between the hydraulic system of Fig. 3 and the heat pump requires substituting an electric generator for pump *B*, an electric motor for water engine *E*, and a refrigeration system for pump *F*, as shown in Fig. 4. The electric motor and refrigeration system are the same as those shown in more detail in Fig. 2. The elevated reservoir *D* represents the fact that electrical energy is a high-grade form of energy (energy which can all be converted into heat or work). The well *G* represents a supply of heat energy at a temperature of 32 F and the reservoir *H* represents a supply of heat energy at a temperature of 70 F. The heat energy is spoken of as a low-grade form of energy because it cannot be completely converted into work. Immediately we run into another question: If the heat energy of the source cannot all be converted into work to drive an electric generator, would it not be more economical to use the heat energy to generate steam for directly heating a building and eliminate the electrical circuit?

A glance at the numerical data of Fig. 4 (which are based on an ideal heat engine, generator, motor and refrigeration system) will partly answer the question just raised. If, as indicated in Fig. 4, 88,812 Btu per hr can be delivered by a heat pump to a building at a cost of 10,000 Btu per hr taken from the source of heat, we are interested again in the reversed refrigeration cycle idea. We will reject the possibility that the exhaust from the heat engine could be added to the heat delivered by the heat pump for a total of 92,441 Btu per hr if they were both located in the same building on the grounds that such a system would not have universal application. There seems to be no end to our confusion; we started out to explain the paradoxical 5 to 1 heat pickup (ratio of the heat energy delivered to the building to the heat equivalent of the power consumed by the heat pump) of a heat pump and now we have given an example of a system with a 13.94 to 1 heat pickup. That is, for each 1.87 kwhr consumed by the motor, a total of 88,812 Btu will be delivered to the building by the refrigeration system, or the heat pickup is $88{,}812 \div (1.87 \times 3413) = 13.94$.

Since the system in Fig. 4 is based on "ideal" equipment, let us assume that if it were reduced to practice it would still have at least a 5 to 1 heat pickup. This brings us back to a question with regard to the hydraulic analogy which should be answered now. Why did the hydraulic system of Fig. 3 turn out to have less than 1 to 1 energy pickup, when we considered the fact that we would have to maintain the elevated reservoir *D* at our own expense, and yet by a generous allowance the heat pump still has a 5 to 1 energy pickup? The answer lies in the fact that the temperature of combustion of a fuel is very high, 1000 F in Fig. 4, relative to the desired temperature in the building. The heat energy liberated during the combustion process obviously should be reduced in temperature before it is used for comfort heating. In the system shown in Fig. 4, the cooling takes place in the heat engine and in so doing the work to drive the generator is produced. The 3629 Btu per hr of heat energy in the engine exhaust is delivered at 70 F but is of little consequence as compared to the electrical energy delivered by the generator and in turn used to drive the heat pump. The hydraulic system analogy of Fig. 3 breaks down because the water available is 100 ft below the ground level and can be elevated to 1000 ft above ground level only by the expenditure of considerable energy, while the heat energy from the combustion of fuel is delivered at a high temperature level by nature.

Why Use a Heat Pump?

There are several reasons why the heat pump will be used even though it has lost the glamour of "perpetual motion"—

1) There is a favorable exchange between the heat energy from the source and that delivered to the building through the heat pump because the heat energy from the outside air needs to be elevated through a narrow temperature range as compared with the wide temperature range decrease for the heat energy taken from the source.

2) The large power plant can use fuel more efficiently than a small heating plant.

3) Many building owners are probably willing to pay the power plant for carrying out the ashes, eliminating smoke and dirt, etc.

But it is high time I was getting to the stated purpose of this article—to suggest some of the reasons the heat pump has fallen short of universal use—

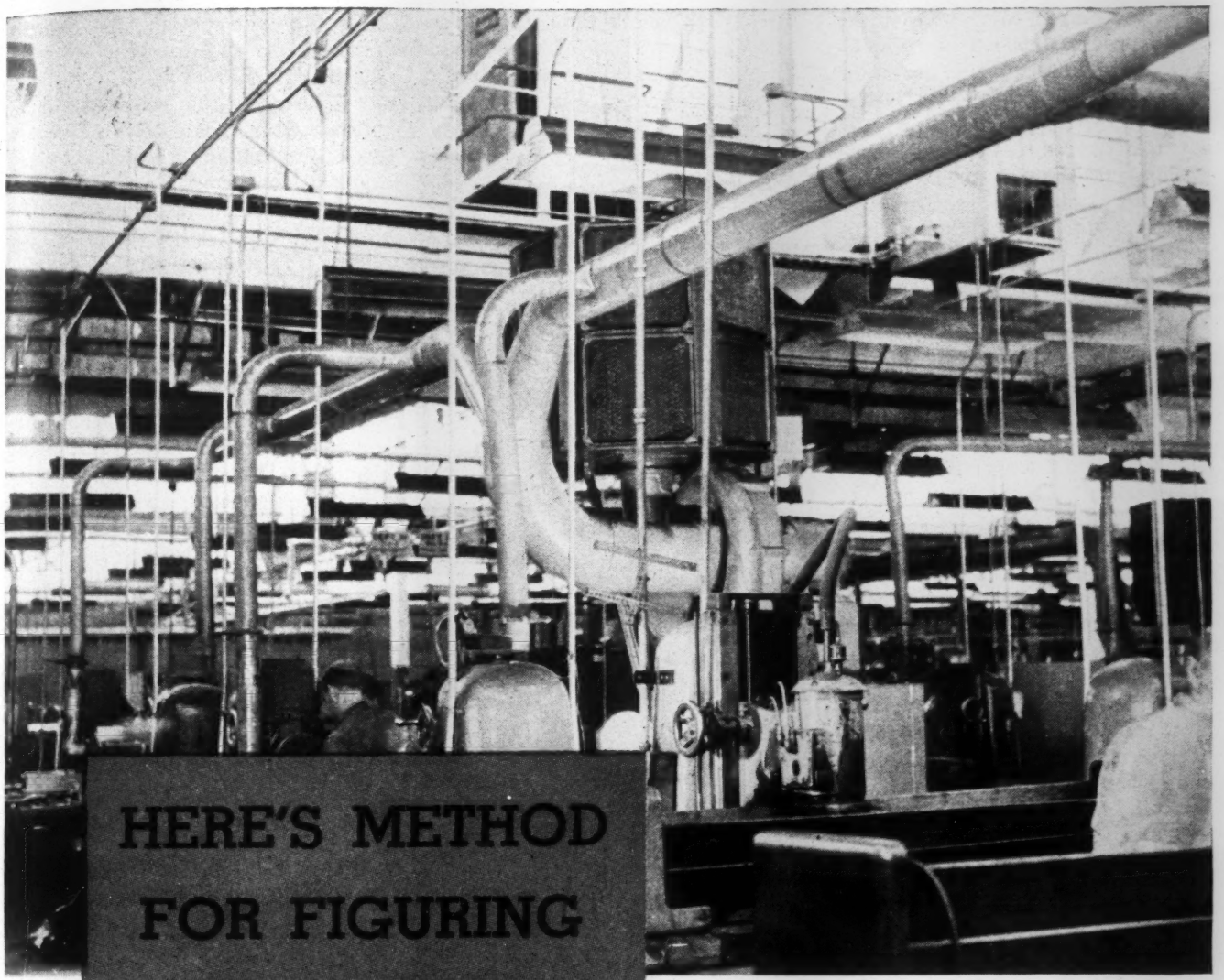
1) Equipment which will take full advantage of the heat pump idea is not available commercially. Practically all of the heat pump systems have adopted (not adapted) conventional refrigeration equipment to a job for which it was not specially designed.

2) Conventional refrigerants have, of course, been used with conventional equipment. There are many reasons to believe that the use of air as the energy-carrying medium in heat pump systems would improve the effectiveness of the system for comfort heating.

3) The demonstration systems using conventional equipment which have attracted much attention because of favorable economics of operation have used a rather high temperature source of energy from the environment. For example, the use of a deep well with 50 F water during the heating season would be much more desirable than 32 F outside air. However, it is rather obvious that each building in a city cannot have a well. The use of a well or other relatively high temperature source of energy will also require auxiliary equipment.

4) The potential demand for year 'round residential air conditioning has hardly reached the point to justify the necessary development work on heat pump systems. It seems rather evident that heat pump systems for winter air conditioning are much more likely to be a reality if the purchaser is willing to pay for summer air conditioning also.

5) Practically no research has been done on the possible applications of the heat pump in the apparently fertile field of industrial heating and process work. The discovery that the heat pump will fit into the heat balance of many industrial plants to give increased economy would be a great impetus.



HERE'S METHOD FOR FIGURING INDUSTRIAL EXHAUST SYSTEMS

Practical Pointers

Operation
Maintenance
Repair
Alteration
Extension

INCREASING ATTENTION is being given to industrial ventilation in the endeavor to improve air sanitation throughout industry. The purpose of this article is to discuss in a practical manner the principles involved in designing a typical industrial exhaust system, and to present a method of tabulating the computations and results so that they can be easily checked by an examining board or other group.*

Fig. 1 is a straight-line layout of the system to be considered. This sketch gives the relative location of the equipment to be exhausted; in this case, five grinding wheels and two grinding booths. Each piece of equipment is assigned a letter and each section of duct is labeled with a number. The layout need not be to scale, for the actual length of each pipe section can be tabulated, as in Table 1.

The quantity of air required to be exhausted from each opening must first be determined. For grinders and buffing wheels, the cfm suggested by state codes and standards associations is usually based on the wheel diameters and the effectiveness of the wheel enclosure. For booths, the determining factor is the necessary face

*This method for presenting data on exhaust systems has been outlined in a manual for a course on air sanitation in industry given for the University of Michigan by W. N. Witheridge. Permission has been obtained to discuss it.

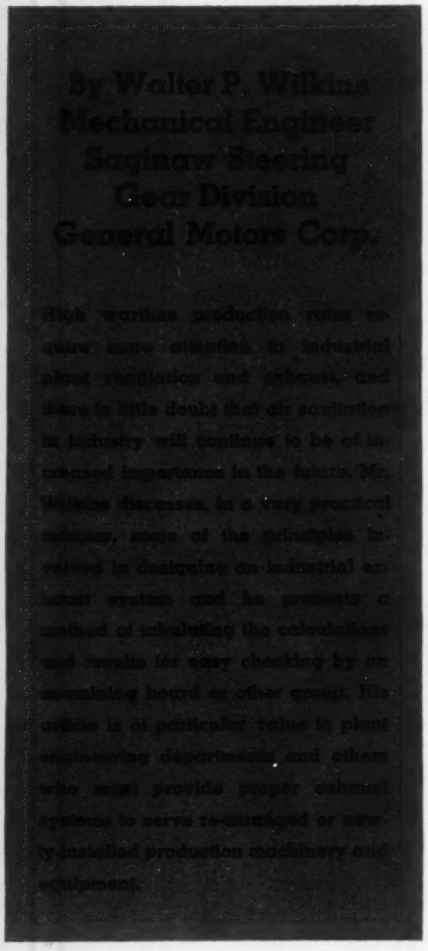
velocity required to counteract the maximum draft conditions. Capacities required for tumbling mills vary in proportion to the barrel diameter. If no particular code must be adhered to, the suggestions of the American Foundrymen's Association, American Standards Association, etc., should be used. The air quantity selected for each piece of equipment in this example is listed on Fig. 1.

The design transport velocity must next be selected, which is the velocity required to pick up and carry the material to be exhausted through the ducts to the collector. The standards associations, state codes, and the manufacturers of exhausting equipment have recommendations for most materials. For designing, a velocity above the minimum recommended should be used so that nearest pipe sizes in inches can be selected without having an actual velocity less than the minimum. For example, in this system being discussed, with ordinary grinder dust to be the material exhausted, 3500 fpm should be the minimum velocity in the ducts and 4000 fpm used as the design velocity.

Prepare a Table

If a table like Table 1 is now prepared listing the information already known, the computations can be tabulated as quickly as they can be read from a slide rule or pipe resistance chart.

The quantity (cfm) of air passing through each pipe section is first listed in column *c*. The quantity in any section of the main is the sum of the branches which have entered the main up to that point.



It should be noted that in column *d* that the design velocity is decreased after the air leaves the filter or collector. At this point, the air being clean, the velocity should be reduced to keep the resistance at a minimum.

Column *e*, the required square feet area in each section of pipe is equal to column *c* divided by column *d* and should be noted in two or three significant figures.

The nearest pipe diameter, column *f*, is readily found by using a table listing diameters of circles in inches and corresponding areas in square feet. At this point it must be decided whether or not the sheet metal worker shall make pipe sizes with diameters in half inches or only in whole inches. It has become quite common practice to use half-inch sizes up to 4 in. diameter and from there on in whole inch sizes only. The sizes have been selected on this basis in this case.

The actual velocity in the pipe size chosen is checked in column *g* by dividing column *c* by the area in square feet of the pipe. This figure can be read quickly from most pipe resistance charts. The results all being above the minimum velocity of 3500 fpm selected, we can proceed.

Determining Total Static Pressure

The remainder of the work is to determine the total static pressure required for the fan and to balance the resistance in the various pipe runs. Continuing with Table 1, the velocity pressure (VP) in each pipe section is noted in column *h*. The velocity pressure, in inches of water, is equal to (velocity in fpm/4000)^2 or can be read from a

Table 1—The calculations are tabulated like this

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
Opening or Hood (See Fig. 1)	Duct Section (See Fig. 1)	Cfm thru Duct Section	Design Velocity Fpm	Req'd Sq Ft of Duct Area	Nearest Pipe Diam., In.	Actual Velocity Fpm	Actual Velocity Pressure, In. of Water	Feet of Straight Duct	Straight Pipe Equil. of Ells, Ft	Total Resistance, Ft of Straight Pipe	Friction per 100 Ft of Pipe, In. of Water	Total Friction Loss, In. of Water
A	1	800	4000	0.200	6 (5½)	4000 (4800)	1.00 (1.44)	10	0	10	4.1 (6.0)	0.41 (0.60)
B	2	300	4000	0.075	4	3500	0.76	15	4	19	4.8	0.92
C	3	300	4000	0.075	4	3500	0.76	15	4	19	4.8	0.92
	4	1400	4000	0.350	8	4000	1.00	10	0	10	2.7	0.27
D	5	500	4000	0.125	5	3700	0.85	20	10	30	3.9	1.17
	6	1900	4000	0.475	9	4300	1.15	5	0	5	2.7	0.14
E	7	600	4000	0.150	5 (5½)	4400 (3700)	1.21 (0.85)	25	15	40	5.6 (3.6)	2.24 (1.44)
	8	2500	4000	0.625	11	3800	0.90	10	0	10	1.7	0.17
F	9	1000	4000	0.250	7 (6)	3800 (5100)	0.90 (1.65)	10	7	17	2.8 (6.2)	0.48 (1.06)
	10	3500	4000	0.875	13	3800	0.90	10	0	10	1.4	0.14
G	11	500	4000	0.125	5 (4½)	3700 (4500)	0.85 (1.27)	15	5	20	3.9 (6.6)	0.78 (1.32)
	12	4000	4000	1.000	14	3750	0.88	10	0	10	1.2	0.12
	13	4000	3000	1.334	16	2900	0.53	5	16	21	0.4	0.09
	14	4000	2000	2.000	20	1900	0.23	30	0	30	0.2	0.06

Table 2—The various losses are summarized

Opening or Hood (see Fig. 1)		A	B	C	D	E	F	G
Velocity Pressure in Branch Leaving Opening, In. of Water		1.00 (1.44)	0.76	0.76	0.85	1.21 (0.85)	0.90 (1.65)	0.85 (1.27)
Entrance Loss in Per Cent of Velocity Pressure		50	60	60	60	60	50	60
Entrance Loss in In. of Water		0.50 (0.72)	0.46	0.46	0.51	0.73 (0.51)	0.45 (0.83)	0.51 (0.76)
Resistance in Each Pipe Section, In. of Water	1	0.41 (0.60)						
	2	...	0.92					
	3	...	...	0.92				
	4	0.27	0.27	0.27				
	5	...	...	...	1.17			
	6	0.14	0.14	0.14	0.14			
	7	...	...	...	...	2.24 (1.44)		
	8	0.17	0.17	0.17	0.17	0.17		
	9	...	...	...	...	...	0.48 (1.06)	
	10	0.14	0.14	0.14	0.14	0.14	0.14	
	11	...	...	...	...	...	...	0.78 (1.32)
	12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
	13	0.09	0.09	0.09	0.09	0.09	0.09	0.09
	14	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Resistance of Collector or Filter @4000 Cfm		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Total Resistance of Each Run from Opening to Outlet		3.90 (4.31)	4.37	4.37	4.40	5.55 (4.53)	3.34 (4.30)	3.56 (4.35)

velocity pressure chart.

The next five columns are used to compute the friction loss from the resistance in the pipe and elbows. The length of straight duct in each section is tabulated in column *i*. The resistance of elbows is usually given in tables in terms of equivalent resistance of straight pipe. The chief variable is the radius of the elbow. For minimum resistance this radius should equal two diameters of the duct. For this example, the equivalent resistance of each elbow is taken as 12 diameters of the duct, *i.e.;* one 4 in. elbow equals 4 x 12 or 48 in. or 4 ft of straight duct. These values are noted in column *j*. The branch connections have been counted as 90 deg elbows. Although the branches should enter the main at no greater an angle than 45 deg, the resistance is considered here as equal to a 90 deg elbow.

Column *k*, the sum of columns *i* and *j*, is the total equivalent resistance of each pipe section in feet of straight pipe.

Because most pipe resistance charts give the resistance in terms of 100 ft of pipe for a given quantity of air and pipe diameter, column *l* tabulates these values for each duct section.† Multiplying column *k* times column *l* and dividing by 100 gives the total friction loss in each section of pipe.

†The author used a pipe resistance chart copyrighted by American Air Filter Co., Inc., for these computations.

Thus far we have determined the losses in terms of each section of duct. Now these losses are combined in Table 2 and the entrance losses added plus the resistance of the filter or collector to give the total resistance from each opening (designated by the letters on Fig. 1) through the shortest route to the outlet.

The entrance losses which are computed in this step represent the loss in energy that occurs getting the air into the pipe at the opening. If the entrance is "streamlined" this loss would be a minimum. However, the more common openings have higher losses which are expressed in percentage of the velocity pressure in the pipe following the opening. These values can be obtained from handbooks and manufacturers' catalogs and should be carefully selected because this loss is usually a good percentage of the total resistance.

The resistance of the filter or collector operating with the maximum dust accumulation which will be tolerated should be used for the design. These values must be obtained from the manufacturer or from actual tests.

It should be noted that the velocity pressure is not added as part of the total resistance because fans are rated in static pressure and not total pressure.

The totals in Table 2 indicate the balance or unbalance of the system as now designed and also the static pressure rating for which the fan must be purchased. If these totals were all equal, the system would be in perfect balance.

Correcting Unbalance of System

There are several ways in which the obvious unbalance of this system can be corrected:

1) A fan could be purchased with a static pressure rating equal to the highest total (5.55 in., the run from opening *E*) and blast gates or dampers installed in each opening which could be adjusted so that each opening received its designed quantity of air. If this method is used, it is suggested that

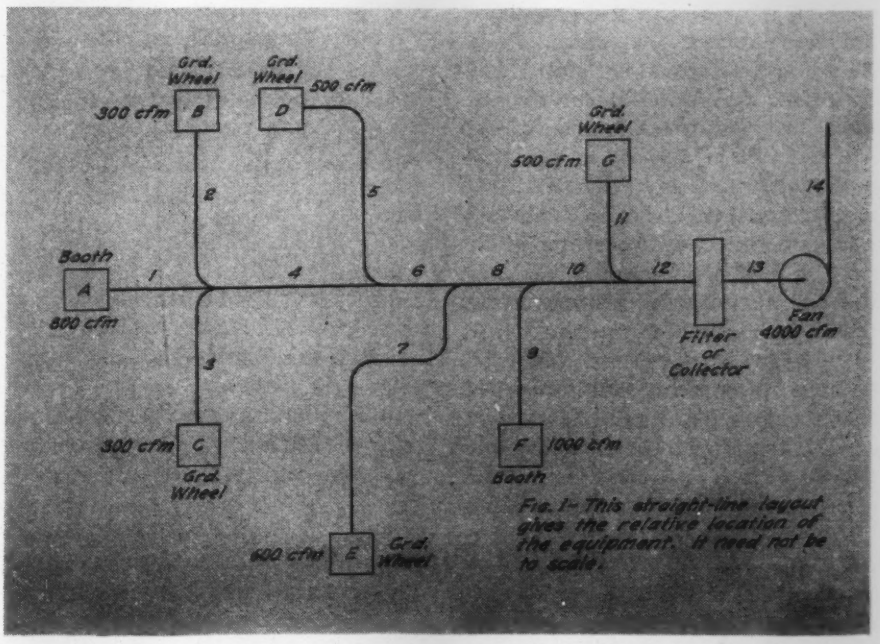


Fig. 1—This straight-line layout gives the relative location of the equipment. It need not be to scale.

the blast gates or dampers be welded in place so that the adjustment cannot be changed. There is considerable misuse of dampers and blast gates and unless properly used they do more harm than good, especially when anyone can change their settings at will.

2) Considering the total resistance in the runs from openings *B*, *C*, and *D* as a mean and disregarding our premise concerning special pipe sizes, different branch sizes from openings *A*, *E*, *F*, and *G* can be selected which will considerably improve the balance. Increasing the branch from *E* to 5½ in. diameter and decreasing the branch sizes from *A*, *F*, and *G*, respectively, to 5½, 6, and 4½ in. diameter, and following through the computation, a fairly good balance is obtained. The figures in parentheses () in Tables 1 and 2 show these changes. It should be noted that it is good practice and is quite often necessary to increase the velocity in branches that are close to the fan to bring about a proper balance. With these new pipe sizes, a fan with a static pressure rating of 4.5 in. could be used.

3) To decrease the resistance in the pipe run from *E*, changing the location of the equipment to shorten the branch pipe or the possibility of lowering the cfm required by more effective hood design should be considered.

In addition to the phases of design discussed in this article, careful attention and thought should also be given to design of hoods and booths; duct fabrication, branch connections, and elbows; fan type required; selection of collector for efficiency desired; recirculation of clean air, or inlet for replacement of air; disposal of collected dirt and dust; and maintenance of the equipment.

THE ADVENTURES OF A POUND OF STEAM 2

OUR FIRST discussion of A.P. Steam and his adventures concluded with the thought that steam is both a container and a ready transporter of energy. Certainly those words are true, but did you ever see a pound of unattended and unbridled steam gallop down Main Street and still be worth anything? It dissipates like the proverbial third generation. Yes, sir! And it causes just as much commotion! This exuberant son by Fire out of Water needs plenty of rein lest he stray from the track, lest he fail to deliver when and where required.

Proper restraints are to be found in the piping system. Directional control is provided by pipes. They not only provide the track or path, but they also act as containers to guard against that exuberant and wasteful dissipation of inherent values of pressure and state. Valves are the traffic signals and policemen who regulate the flow. Gate and globe valves are used to shut off or permit flow, and the latter are also used to throttle or vary the quantity flowing. Check valves have definite and predetermined ideas as to the direction of flow.

There are many variations of these basic types of valves and there also are a few other basic types designed to overcome some of the shortcomings of the regular gates, globes, and checks. Before following A.P. Steam's adventures it is well to consider the why's and wherefore's of the "old line" types of valves.

A SUBSCRIBER suggested to the editor recently that a series of articles on what happens to a pound of steam as it travels through an industrial piping system would be of interest to him and—he thought—to many others. Mr. Kirkwood, a member of HPAC's board of consulting and contributing editors, agreed to write about some (at least) of the adventures of A.P. Steam, and in the January issue he established the character of our hero by reference to a set of steam tables. This month, he discusses some of the restraints put upon his natural exuberance by valves of various types, each of which exacts some penalty in friction loss.

Gates and globes are used as shutoff valves. For all practical purposes the gate of a gate valve is a dam or barrier that can be slid across the face of an opening in the pipe. This opening must have smooth faces to insure tight seating between the sliding barrier and the pipe end. If full pipe area is to be maintained, the valve designer must provide an annular channel outside the pipe area for the seats. Likewise, he must provide an enclosed space for the barrier to rest in when it is withdrawn. This latter is the valve bonnet, including a neck that may be a part of the valve body. When the gate valve is open for full flow, the full area of the pipe is available—at least, in most valve designs. Unfortunately, the annular channel and the bonnet present both a sudden increase and a sudden decrease in cross sectional area of the conduit, thus creating appreciable turbulence in the flowing stream. However, as will be seen from later discussions, the gate valve is relatively a low loss valve. It is a dependable workhorse for the piping designer.

The globe valve is a different animal, most useful for certain types of work and an infernal nuisance if improperly applied. In this valve (except for certain modified designs) the barrier remains in the stream flow. The barrier or disc is suspended normal to the valve stem and the flow through the valve

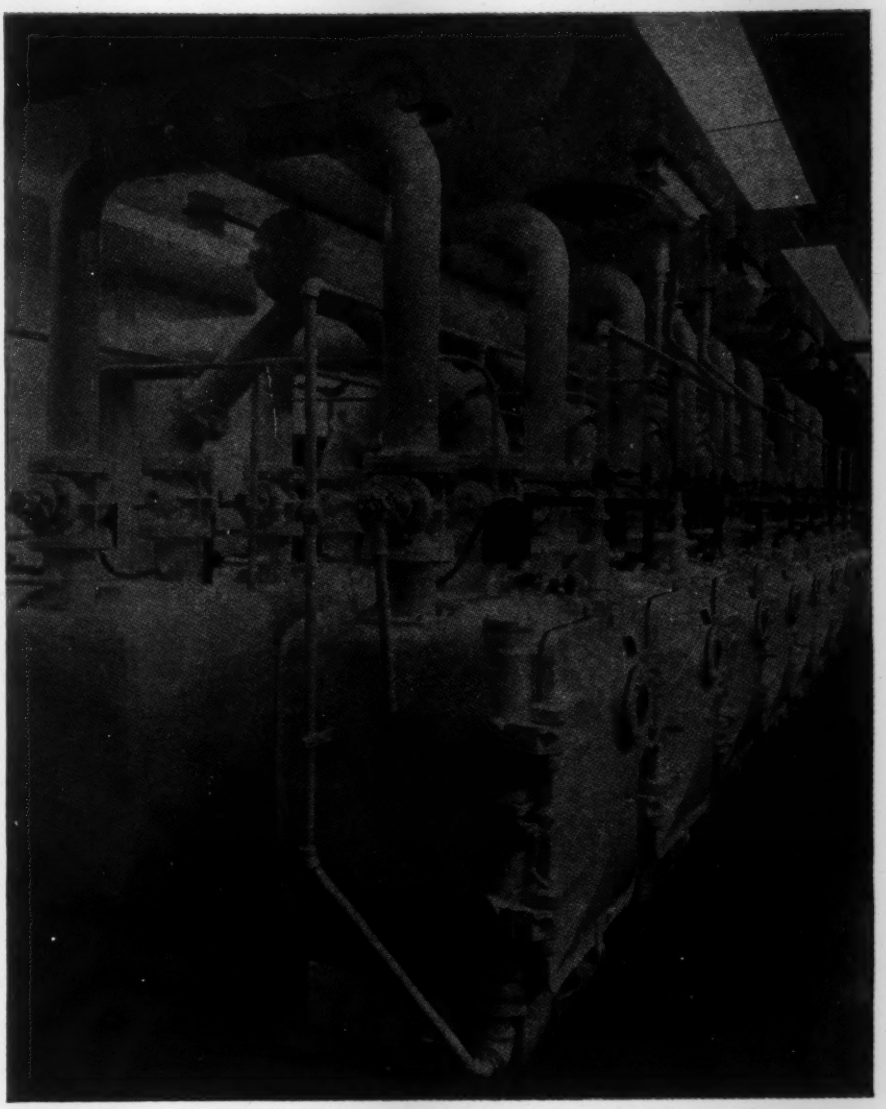
By A. C. Kirkwood
Burns & McDonnell Engineering Co.
Consulting Engineers

proper is between the disc and the seat which mates with the face of the disc near its periphery. Since the stem must reach to the operating handwheel outside the valve body, the plane of the disc is usually parallel to the longitudinal axis of the pipe. Thus, the valve designer is faced with the necessity of providing internal barriers to carry the seats. Usually, approximately the lower half of the pipe area is blocked on one end of the valve and the upper half on the other end. These blockades are so formed that a circular (annular) seat is formed against which the disc can be forced home. Our pound of steam is due for a real roller coaster ride when he goes through this valve—up and over, down and under, and in the meantime getting mixed up with the disc plus several changes of velocity, with turbulence enough to upset anyone. No wonder that this valve is charged with high friction losses!

But the globe valve does have good points, too. Unlike the gate valve, it can be used to throttle flow. In theory, fluids will pass between the disc and seat at uniform rates for each increment of disc periphery. The flow being uniform, the disc can be positioned as desired and there are no sliding surfaces to drag and gall. Down to the point where wire drawing occurs, the flow can be reduced at will without damage to the valve. Modified types of globe valves are excellent throttling valves. But one must always reckon with the inherent loss of the globe design.

Angle valves are globe valves built into an elbow, so to speak, and many so-called "straightway" valves are globe valves whose stem has been inclined at an acute angle to the center line of the pipe. Both of these modifications have lower losses than the true globe type.

Check valves have an exclusive agreement to permit traffic in one direction only. Basically, gravity is used to drop a swinging barrier or a free ball over an opening whenever there is insufficient force in the flowing fluid to hold the barrier or ball away from the valve seats. Should the direction of flow reverse, the differential pressure causing the reversed flow will force the valve closed, seating it tightly and preventing reversal of flow.



Valves are the traffic signals and policemen who regulate flow in industrial piping systems and each exacts a penalty in friction loss, whether the fluid being piped is steam, water, air, gas, oil, or some process material. This photo indicates the importance of piping and valves in the mass production of penicillin. Vials containing the frozen penicillin are placed in these dehydrators where the high vacuum removes the moisture and leaves the penicillin salt as a yellow powder deposited in the bottom of each vial. (Acme photo)

Gate valves are distinguished by having either a solid wedge as a movable barrier or by use of two barriers linked by loose toggles that are forced home on the seats when separating wedges strike anvils as the valve reaches the closed position. The losses through both types are similar and the former type is used in most cases for steam and high pressure water services.

Globe valves are of the disc type with modifications employing plugs or cones in place of a disc. In the latter types the seats are tapered with the flow, thus reducing to some extent the inherent friction losses. Another modification employs a cylindrical slotted cage with a narrow beveled seat for final closure.

Check valves have been modified to insure closure by using springs or other external forces to aid gravity. Light poppets, single or multiple, with loading springs are used in some cases. Tendency to slam, where sudden reversal of flow is expected, has been minimized by various means, notably in one type where the swinging disc is hinged below the top of the disc. Closure is thus somewhat retarded by the action of the upper part of the disc. In this type of valve the seats must be and are tapered so that closure is akin to that of a cone or plug.

HOW TO KEEP FUEL USE AT A MINIMUM

In an endeavor to cope with the fuel shortage resulting from the extreme cold weather and transportation difficulties, an effort should be made in every possible direction to conserve fuel. The following suggestions were sent last month to superintendents of many buildings in New York City by members of the Real Estate Board of New York:

Heating Plant—Be certain that the plant is kept in efficient operating condition.

Boilers should be blown down frequently enough so that water is kept clear, and sufficient treatment added to prevent formation of rust and scale.

Fire tubes and gas passes must be kept free of soot and fly ash. Check conditions at least weekly, and clean as often as necessary.

Keep boiler insulation in good condition and be sure flue doors and steam pipes are well covered.

Seal leaks in boiler settings, around doors, and in breeching joints.

Be sure pressure regulators operate freely and are set for the minimum pressure needed for circulation of steam.

Be sure grate bars are intact so that no coal is lost through the grates.

Keep fire beds clean but not too thin.

Heating System—The system should circulate freely and all radiators should heat evenly.

If there is difficulty in providing steam to any radiators the local trouble should be corrected so that the rest of the building does not have to be overheated in order to supply steam to one part.

Quick vent valves and air valves must expel air freely.

Trap elements should be tested occasionally to be certain that they open and close at proper temperatures. Trapped mains or branch lines should be repitched to avoid air and water pockets.

If any room is short of radiation, do not try to heat the room by supplying more steam. It is cheaper in the long run to install additional radiators.

Heat Supply—Furnish only the amount of steam necessary to maintain comfortable conditions.

In the morning, furnish steam at as late an hour as possible to have the building comfortable when the tenants need the heat.

In the evening, turn off steam as early as possible. Buildings will retain heat for an hour or two after the steam is discontinued.

If you have a temperature control, set it so that 70 deg is maintained during the day. Maintaining temperatures of higher than 70 deg must be avoided. If sufficient fuel cannot be saved by other economies, it may be necessary to reduce room temperatures to 65 deg.

If you do not have a temperature regulator, shut off steam for an hour or two in mid- morning and mid-afternoon. In mild weather sufficient heat may be provided by supplying steam for an hour in the morning, another hour around noon, and in residential buildings, an hour or two at dinnertime. If you believe some form of automatic temperature or time control would be an advantage in your building, notify the office to that effect.

In vacant spaces in mild weather all radiators can be kept off except in kitchens or bathrooms. In cold weather not more than one out of three radiators should be kept on.

Reduce Heat Losses—Theoretically, if a building could be sealed against loss of heat no steam would be required.

Check all outside windows and doors to make certain that they close tightly; try to induce tenants to keep windows locked closed.

Weatherstrip leaking windows and doors.

Operate ventilating system only when necessary and at as slow speeds as possible.

Much heat is wasted by conduction through walls behind radiators. There are available insulating boards which can be set between the radiator and the wall to reduce this loss; the use of these boards should result in a substantial saving in steam requirements.

If there are humidifying devices they should be kept filled with water since increasing the humidity makes the room feel warmer.

Wherever possible, keep shades drawn to reduce loss through windows.

It is suggested that inspections be made of the exterior of the building from time to time to determine how many windows are open. If a fair percentage of windows are open it should indicate that too much steam is being supplied. Tenants who regularly keep windows open should also keep their radiators shut off.

Hot Water—Be sure hot water plant is clean and in good operating condition.

Be sure heaters, storage tanks, and main hot water lines are covered.

Keep temperature as low as possible consistent with maintaining circulation.

Inspect faucets frequently to be certain that they do not drip.

Turn off hot water heaters at night wherever possible.

—L. W. MAUGER, chairman, fuel committee, management division, Real Estate Board of New York, Inc.; and supervising engineer, Brown, Wheelock, Harris, Stevens, Inc.

Design of Vent Piping for Safety Valves

By Paul L. Geiringer

DESIGN OF safety valve vent piping is a matter of importance, especially in the case of large high pressure power plants where even four, eight, or more safety valves may be installed on a single boiler and where vent pipes may be required to discharge steam at a rate of 200,000 lb per hr. Incorrectly sized vent pipes may cause steam to discharge from the bottom of the risers at the drip pans. Improperly designed supports are a serious hazard as the forces created by the discharging steam are rather high and these forces can cause harm to equipment and personnel.

The purpose here is to present a rational method for determining the steam conditions at the important points in safety valve piping with a degree of accuracy sufficient to enable the designer to select with assurance the proper size for any case. It is further intended to throw some light on the rather complex phenomenon, and to endeavor to represent the changes of state in a thermodynamic diagram—a method used most advantageously in engineering analyses.

Fig. 1 shows in simple form a usual arrangement of a safety valve and vent pipe serving either a boiler or a superheater. For any actual condition the size of the safety valve is determined in accordance with the boiler code and the relieving capacity given by the safety valve manufacturer under the steam pressure and temperature existing in the boiler or superheater. Fig. 2 shows the arrangement in diagrammatic form, considering the safety valve as a nozzle of poor overall efficiency and the discharge elbow as an equivalent length of pipe.

The steam discharges from the boiler or superheater at point *1* into the converging connection to the throat at point *2*. Passing through the throat at *2*, the steam jet expands until it strikes the walls of the valve body or the discharge elbow at point *3*. It flows through the discharge elbow to point *4*, whence it jets forth and

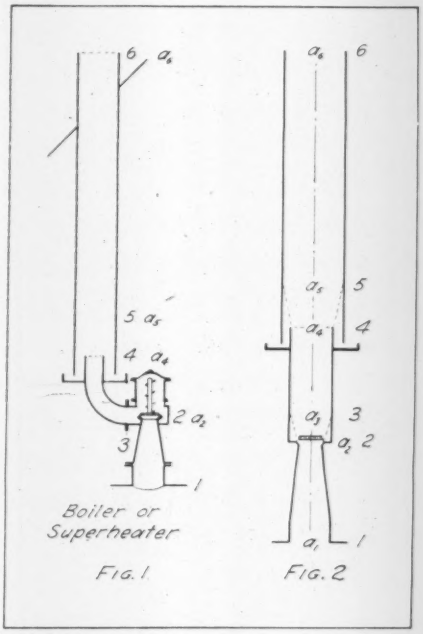


Fig. 1 Fig. 2

expands to strike the walls of the vent pipe at point *5* and then proceeds through the vent pipe to the outlet at point *6* and to the atmosphere. The location of neither point *5* nor point *3* can be determined accurately, but this is of no importance.

The sketches indicate that the vent pipe is not attached to the valve discharge elbow and therefore an opening exists at the bottom of the vent pipe through which steam could discharge into the boiler room if the vent were not of the proper size. Vent pipes, if very short, are sometimes connected to discharge elbows, but generally they are not attached for two practical reasons—to avoid imposing weight and the downward expansion forces of the vent pipe on the valve elbow and to minimize the possibility of condensation and rain-water running back into the valve body. In the usual case, then, there is the problem of so designing the vent pipe that steam will not discharge from the bottom of the vent pipe.

The energy accumulated in the steam is changed into velocity by leaving the boiler through area a_1 and the mass of steam is thus accelerated until it reaches the valve opening a_2. In the valve opening, a velocity equal to the acoustic or critical velocity—corresponding to the pressure, density, and temperature of the steam—is created. Complying with the continuity equation (given below) from there on, a further acceleration takes place because the cross-section a_3 is larger than area a_2. In striking the bend wall at point *3*, and due to the restriction imposed by the following bend, the velocity is retransferred into pressure arriving at point *4*. Sound velocity corresponding to the condition of the steam at point *4* may be reached. A similar process repeats itself leaving area *4*: acceleration of the velocity during the crossing of the interval, retransformation of the velocity into pressure at point *5*, and rechanging of this pressure into velocity until point *6* is reached. The steam leaves the vent pipe through area *6* mostly with acoustic velocity—sometimes also with somewhat lower speed at a pressure equal to or above atmospheric pressure.

IMPROPERLY sized vent pipes for safety valves may cause steam to discharge from the bottom of the riser at the drip pan, and incorrectly designed supports for such piping create a hazard. Mr. Geiringer—registered professional engineer, staff member at Massachusetts Institute of Technology, and formerly research engineer for a large pump manufacturing company—has worked out a method for vent piping design which is partly graphical and partly mathematical. He explains it here . . . This method of calculation was used in connection with a 1400 psi boiler and 50,000 kw turbine installation which was put into operation in 1943.

The Fanno Curves

In order to investigate this sequence of processes, a partly mathematical and partly graphical method may be used. The operating condition of a nozzle or pipe combination can be investigated by designing the so-called "Fanno curves" for the relations of the various diameters of the piping system in relation to the steam weight G passing through this piping system. This family of curves is a very effective tool for clarifying the different changes in the condition of the steam passing through a nozzle or through a combination of nozzles and pipes as shown in Fig. 2.

The Fanno curves were first described in a thesis by Fanno in 1904. These curves represent the geometric locus of the steam conditions in a nozzle or pipe satisfying simultaneously the energy and the continuity equations:

The Energy Equation

$$\frac{A\ (w_1^2 - w_x^2)}{2g} = h_1 - h_x$$

The Continuity Equation:

$$G\ v_x = a_x\ w_x$$

(wherein a_x is in square feet)

The subscript "x" indicates the condition at any point. A represents the reciprocal of the mechanical equivalent of heat.

These curves represent the condition of the steam from point *3* to *4*, and from point *5* to the exit at point *6*. In the intervals *2* to *3* and *4* to *5* the continuity is interrupted as the movement and the expansion of the steam is not more restricted by the pipe walls. Therefore, the continuity equation is not valid in this interval. Between points *1* and *2* a nearly adiabatic flow with slightly increased entropy exists.

If we combine the two equations and substitute the numerical values for A and for g we get the simplified equation:

$$w_x = 223.7\ \sqrt{h_1 - h_x} \ldots\ldots [1]$$

We assume that the velocity of the steam w_1 leaving the boiler is zero.

The continuity equation written with a_x in square inches is:

$$G\ v_x = \frac{a_x}{144}\ w_x \ldots\ldots [2]$$

These two equations combined give the equation of the Fanno curves:

$$v_x = 1.55347\ \frac{a_x}{G}\ \sqrt{h_1 - h_x} \ldots\ [3]$$

The Fanno curves can now be drawn for the different relations of a_x/G. We can plot these curves on the various diagrams which are in use. The most practical would be to draw them on a diagram which contains entropy, pressure, enthalpy, and constant volume lines. Some temperature-entropy diagrams contain nearly all of these lines—especially the constant volume lines—and therefore the plotting would be most simple. However, the practical engineer seldom can make use of such a diagram, because most of the steam tables do not contain—as far as the author knows—such a diagram large and accurate enough for the purpose. It may, therefore, be necessary to use a large enthalpy-entropy diagram.

It will, therefore, be required to calculate from the volume v_x, which is found from the preceding equation, the coordinated pressure p_x, which corresponds to the condition of the steam described by v_x and h_x. Fig. *3* shows in an entropy-enthalpy diagram two sets of such Fanno curves illustrating the state of the steam in a 4 in. and a 5 in. bend attached to a 2½ in. and a 3 in. safety valve called "B" and "C," belonging to a superheater of a 1400 psi boiler, and for the state of the steam in the 8 in. and 10 in. vent piping into which these two valves discharge.

To simplify the drawing and to make it more clear, solely the curves for the *correct* diameter-weight relations are shown. However, it may sometimes be necessary also to draw curves for additional diameter-weight relations before ascertaining the correct size. This is not at all complicated, because these curves can be drawn after determining only three to four points.

Symbols

a = area of cross section, sq in.
$A = 1/J = 1/778.26$ Btu per ft-lb.
d = pipe diameter, in.
g = gravity acceleration = 32.2 ft per sec per sec.
G = weight of steam flowing, lb per sec.
h = enthalpy of steam in Btu.
J = mechanical equivalent of heat = 778.26 ft-lb per Btu.
$k = c_p/c_v$ = ratio of specific heat at constant pressure to specific heat at constant volume.
K_1 = constant in Unwin formula.
L = equivalent pipe length, ft.
m = subscript to denote steam condition at point of maximum steam velocity.
p = pressure of steam, psi absolute.
p_f = pressure drop caused by friction, psi.
s = entropy of steam.
t = steam temperature, F.
v = specific volume of steam, cu ft per lb.
w = steam velocity, ft per sec.
W = weight of steam flowing, lb per hr.
x = subscript to indicate any arbitrary point.
x = percentage of moisture in the steam.

Acoustic or Critical Velocity

The acoustic or critical velocity is the maximum velocity attainable by the steam in conduits with parallel walls; it can only be exceeded in a pipe with divergent walls, or in steam jets not limited by any solid boundaries. This maximum velocity is at the same time the velocity of sound in steam. It varies with the steam pressure, the steam temperature, and also with the relation of the specific heat at constant pressure to that at constant volume. This relation, c_p/c_v, is usually called k. The value of k for superheated steam is approximately 1.3 and for saturated steam it varies according to the percentage of moisture content, x, of the steam. For dry saturated steam the value for k is sometimes given as 1.135 and sometimes as 1.035. Various formulas are offered for calculating k for saturated steam. Stodola sets k equal to $1.035 + 0.001\ x$, and Zeuner sets k equal to $1.135 - 0.001\ x$. Sometimes tables are given instead of formulas. (See Marks' Mechanical Engineers Handbook.)

The maximum velocity will be reached in the throat of the valve. This maximum velocity will be denoted by the subscript (m). The condition of the steam leaving the boiler is denoted by the subscript (1).

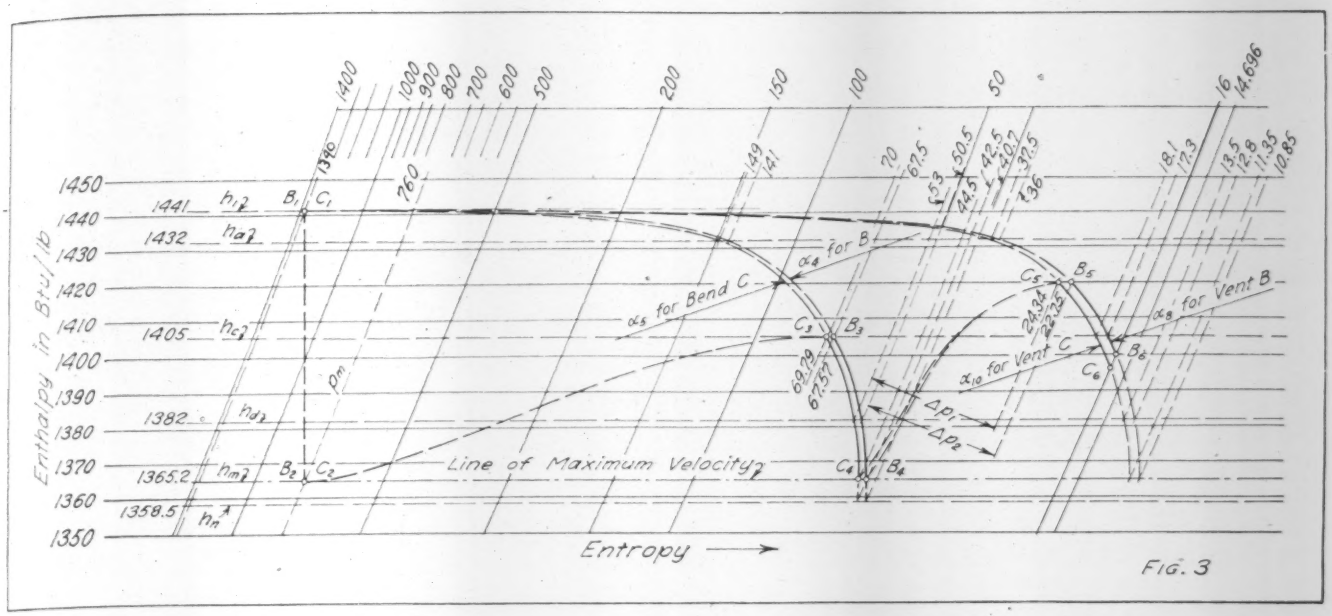


FIG. 3

The velocity and the pressure in the throat can be evaluated from two well-known formulas for the critical velocity:

$$p_m = p_1 \left(\frac{2}{k+1} \right)^{\frac{k}{k-1}} \quad \ldots\ldots\ldots [4]$$

and

$$w_m = \sqrt{2g \left(\frac{k}{k+1} \right) p_1 v_1} \quad \ldots [5]$$

In these formulas the pressure is given in lb per sq ft and the throat area is in sq ft.

Combining these formulas with the formula $w_m = 223.7\sqrt{h_1 - h_m}$ we get the following formulas:

$$p_m = p_1 \left(\frac{2}{k+1} \right)^{\frac{k}{k-1}} \quad \ldots\ldots\ldots [6]$$

$$c_2 = \left(\frac{2}{k+1} \right)^{\frac{k}{k-1}}$$

$$p_m = c_2 \; p_1 \quad \ldots\ldots\ldots [7]$$

$$w_m = \sqrt{(12)^2 64.4 \left(\frac{k}{k+1} \right) p_1 v_1}$$

$$c_3 = \sqrt{(12)^2 64.4 \left(\frac{k}{k+1} \right)}$$

$$w_m = c_3 \sqrt{p_1 v_1} \quad \ldots\ldots [8]$$

$$h_m = h_1 - \frac{144(2g)\left(\frac{k}{k+1} \right)}{(223.7)^2} p_1 v_1$$

$$c_4 = \frac{144(2g)\left(\frac{k}{k+1} \right)}{(223.7)^2}$$

$$h_m = h_1 - c_4 p_1 v_1 \quad \ldots\ldots [9]$$

It is remarkable that the acoustic velocity v_m of the steam depends solely upon the condition of the steam leaving the boiler. In our problem in Fig. 3 this is $p_1 = 1390$ psi and $h_1 = 1441$ Btu.

Pressure Drop Due to Friction

The pressure drop due to friction of the steam on the pipe walls can be shown on the Fanno curves. The point with the subscript 3 on Fig. 3 represents the state of the steam entering the bend and with the subscript 4, the state leaving the bend. Similarly the points with the subscript 5 represent the steam state entering and with the subscript 6, leaving the vent pipe.

A method will be outlined in detail in a second article to locate the points B_5 and C_5, as well as B_3 and C_3.

Numerous formulas for determining the pressure drops in pipes are available. The Unwin formula is simple and exact enough for these calculations and a constant K_1 is used equal to

$$\frac{0.3628}{10^7} \left(1 + \frac{3.6}{d} \right).$$

The formula then reads:

$$p_f = \frac{K_1 W^2 L v}{d^5} \quad \ldots\ldots [10]$$

or simplified, it can be expressed as follows:

$$p_f = 0.4687 \left(1 + \frac{3.6}{d} \right) \frac{G^2 L v}{d^5} \quad \ldots\ldots\ldots\ldots [11]$$

This formula can be used best provided a correction for the change of the volume with the pressure is introduced. This is done by *estimating* the mean value (v_{me}) for the volume, and rechecking.

The Criterion for Avoiding Discharge Back Into the Boiler House

We have compared the change of steam conditions between points *1* and *4* with the behavior of steam passing through an orifice. We do not know, however, the efficiency of this orifice and can therefore not determine what the pressure regain will be from point *2* to point *3*. It seems, therefore, safe to locate point *4* on the critical speed curve corresponding to the lowest possible pressure, notwithstanding the fact that it may also be situated on a somewhat higher pressure line. It certainly cannot be located on a lower pressure level as corresponding to the crossing point of the Fanno curve of the bend diameter with the critical velocity curve, because the critical or maximum velocity cannot be overstepped in parallel conduits. The placing of *4* at this crossing point is, therefore, a justifiable safe assumption as long as no exact tests are available which would permit the assumption of a higher pressure level.

The steam leaving the pipe bend of the safety valve at point *4* has an energy which is materialized in all three energy forms of steam —pressure, heat, and velocity. It is the same amount of total energy which is contained in the steam

[*Concluded on Page* 138]

"Open for Discussion"

WARTIME FUEL EFFICIENCY

THE EDITOR—

I appreciate your sending me a copy of the article Wartime Fuel Efficiency—A Review of Combustion Elements, by Kalman Steiner, published in the January HPAC, and feel honored that you have asked for criticism of it. I think that it is very well written and can be readily understood by the layman. I have no criticism whatever, but have one suggestion. On page 33 there is a paragraph which reads:

"Other losses in the average boiler plant include unburned combustible in the clinker from solid fuels, moisture in fuel and air supply, soot formation (smoke), radiation from the setting, and latent heat in the water of combustion."

There are two additional losses generally found in the average plant, namely: siftings through the grate, which amount to a considerable item on certain types of industrial stokers; also an item of fly ash loss. In the majority of plants, the siftings are put back with the coal being used. However, fly ash is more generally discarded, although I know of several plants where it is mixed with bituminous and fired in spreader type stokers. Naturally, it depends upon the use made of the siftings and fly ash whether these should be considered as a loss.—E. E. FINN, consulting engineer, Anthracite Industries, Inc.

ISOMETRICS OF ADVANTAGE FOR PIPING DRAWINGS

THE EDITOR—

Referring to the article Isometrics of Advantage for Piping Drawings, by V. L. Sherman, published in the February issue, I think the author's use of the word "perspective" is incorrect. He implies that isometric drawing is a form of perspective drawing, which is not true. Reference to the accompanying table, which is in agreement with accepted usage, will show that isometric projection is a form of axonometric projection, which in turn is a form of orthographic projection. By changing the words "perspective" to "pictorial," and "orthographic" to "multi-view," in the article, the meaning will be more clear to those who are familiar with the correct definitions of the terms involved.

Classification of drawings and projections

Basic types of projections used in engineering drawings

- Orthographic. (Projectors perpendicular to plane of projection.)
  - Multi-view drawings
  - Axonometric
    - Isometric
    - Dimetric
    - Trimetric
- Oblique. (Projectors parallel to one another and oblique to plane of projection.)
  - Cavalier
  - Cabinet
  - General Oblique
  - Clinographic
- Perspective. (Projectors converge at point of sight which is located at a finite distance from the object.)
  - One point
  - Two point
  - Three point

Note: Multi-view drawings are ordinarily used for working drawings. All of the other types of drawings listed above are pictorial drawings in which an attempt is made to represent the object in one view.

The author's application of isometric to *P-V-T* diagrams is not new (see p. 338, Engineering Drawing, by Jordan and Hoelscher, 3rd edition, John Wiley and Sons, New York). I do not think, however, that it should be excluded from the article.

Since the author "takes a crack" at teachers for not teaching pictorial drawing, may I goodnaturedly defend my profession by stating that during my 21 years of teaching, all engineering students at the University of Illinois have been taught isometric, oblique, and perspective drawing. The same applies to most schools. It is rather that those in industry have been slow in adopting pictorial drawing for daily use in the shop. Under the impetus of war conditions pictorial drawing has come into its own because both the skilled and the unskilled can read a pictorial more easily than a multi-view drawing. At present, I am engaged in teaching "pictorial drafting for industrial production" in connection with the war training program of the University of Illinois.

The isometric "grid" suggested by Mr. Sherman in his article offers a rapid means of making isometric drawings. Those who use this type of drawing would do well to try out the scheme illustrated.

The drawings resulting from the use of a grid constructed as described are true isometric projections. The lines on the grid are isometric lines. Any planes determined by two intersecting isometric lines are isometric planes. By the method suggested, the isometrics of circles which lie in isometric planes are ellipses whose major axes are to scale. The same is true of ellipses representing circles in other than isometric planes.

A sheet of 35 deg Lietz ellipse guides will be found to be very convenient for representing circles in isometric planes. The specific sheet in mind is No. 3235-35 manufactured by the A. Lietz Co., San Francisco 11, Calif. The ellipses on this sheet have major axes varying from 5/32 to 2 in. These ellipses are accurate enough in size and proportion for isometric drawing.—ALBERT JORGENSEN, assistant professor of general engineering drawing, University of Illinois.

WHEN ENGINEERS gather to hear a paper or talk, there comes a time when the meeting is thrown "open for discussion." We follow this custom in these columns, which provide an opportunity for readers to comment and discuss articles published in HPAC and other topics of interest to heating, piping, and air conditioning engineers and contractors. Others are interested in your views on these matters, and the editors will welcome your remarks. Address them to Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

CALCULATING TABLE

for Pipe Bends and Flange Alignment

By E. W. Winchester
H. A. Kulfian & Co.
Engineers & Constructors

This method of calculating pipe bends and flange alignment was developed by Mr. Winchester after years of working with the conventional method, and has been shop checked on actual pipe assemblies. The formulas have been used in connection with the prefabrication of piping for a cement mill, a catalytic treating unit, detailing of bends for marine piping, and on other projects. The method of aligning flanges has been found particularly useful, as formerly when such a problem occurred, lap joint pipe flanges were used, or if only simple alignment was required, one of the flanges was shipped loose for field alignment and final assembling. According to Mr. Winchester, draftsmen who in the past have consistently made mistakes in calculating pipe bend angles are able to arrive at the correct answer on their first draft when using the method he outlines here.

INCREASED USE of piping in industrial processes has resulted in much congestion in plant areas which formerly were comparatively clear. When piping was used merely to carry water, steam, or the lighter oils, a few extra changes in direction were not objectionable and often advantageous. However, where piping is called upon to carry such materials as clay, cement rock, or cement under pressure, where the resistance offered by changes in direction is high, and where such items as minimum slope and space must be considered, the use of pipe bends, both center lines of which are not in the same horizontal or a vertical plane, increases.

Such bends have always been a necessary feature of ship piping. Formerly these bends have been fabricated from full sized templates, each a custom-made job. Under present conditions, the trend has been to farming out this work on a mass production basis. Since it is not practical to ship these templates so as to preserve their shape, the bends must be detailed in the same manner as for ordinary piping.

The traditional method of calculating these bends was satisfactory when only an occasional one was used. It is a slow and disconnected process. One must determine the sides of the triangle which define the plane of the bend and then solve this triangle for the angle desired. If the bend is flanged, the detailer has made no progress toward locating the "straddle center line" for the bolt holes. The fact that the process is disconnected increases the possibility of mistakes in the calculations.

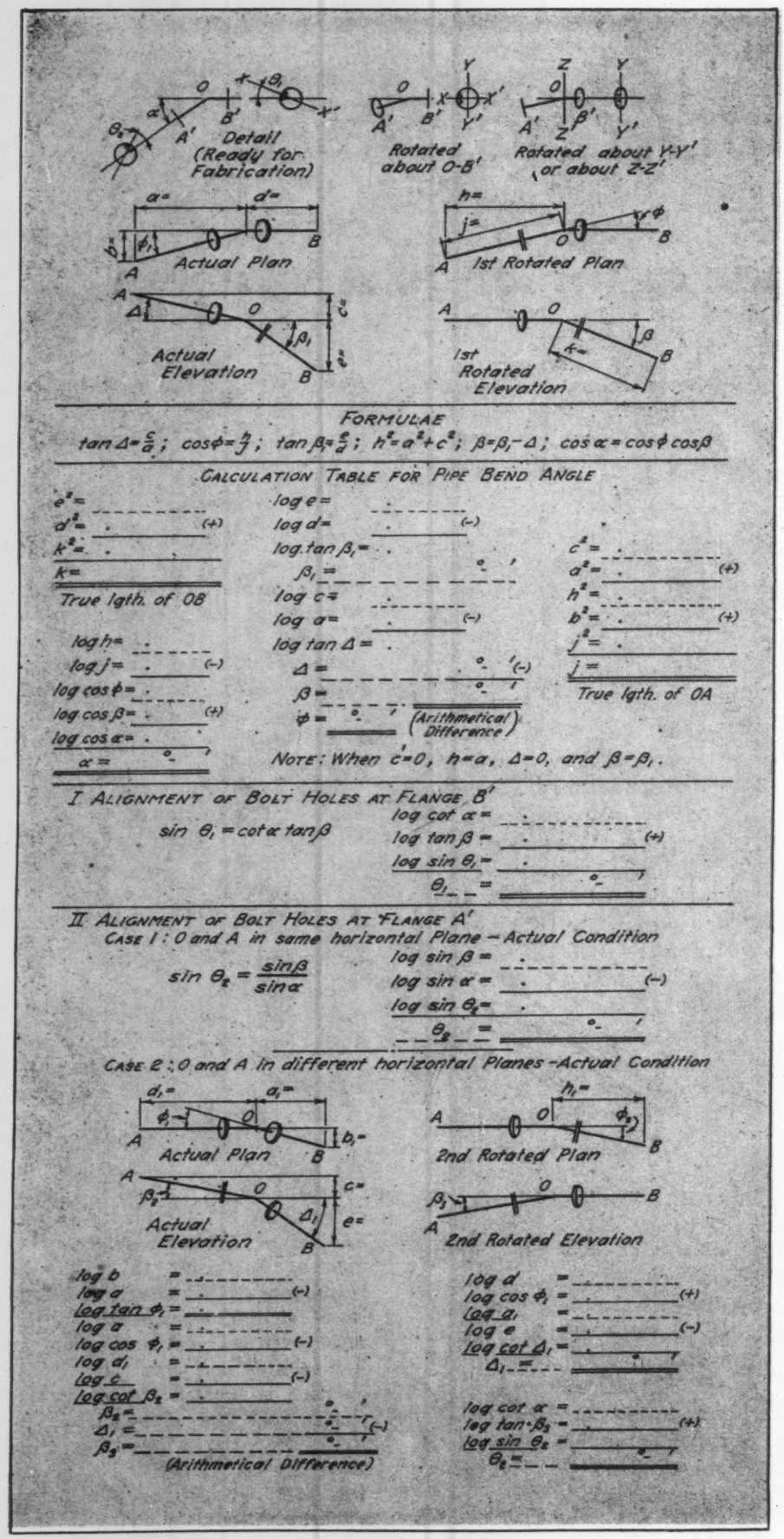
Often a pipe bend requiring this treatment is adjacent to a simple pipe bend (one in which both tangents lie in the same horizontal or vertical plane). Using the traditional method, each bend must be calculated separately. Using the cosine method, the angle of the simple bend is generally one of the projected angles of the rolled bend. Consequently, one set of calculations is sufficient for both bends.

Any calculation is simplified when the steps can be tabled and the logs and squares of the dimensions entering into the calculations so arranged that the calculator can enter all of them in the table before any arithmetic is performed. This is possible if the cosine method is used, and the suggested form is shown in the accompanying calculating table.

The basic expression for the angle is obtained when one center line is in a horizontal plane (rotated views in the calculating table), that is: cosine α = cosine ϕ $\times$ cosine β, where α is the true angle, ϕ is the angle between the horizontal projections of the two lines, and β is the angle which the one sloping line makes with its horizontal projection. This formula may be readily tested by assigning values of 0 deg and 90 deg alternately to ϕ and β.

Although this single formula covers many conditions found in the calculation of pipe bends, the accompanying tabular form was generalized to include all original conditions. In order to make the formula usable when neither line is in a horizontal plane, the object must first be rotated so that one line is in a horizontal plane. The rotation is about a horizontal axis through O and perpendicular to line OB. Such rotation is automatically taken care of by the calculator by entering the dimensions on the views and following through with the squares and logarithms of the dimensions in the calculations.

The calculations for the true lengths of lines OA and OB have


Detail (Ready for Fabrication)
Rotated about O-B'
Rotated about Y-Y' or about Z-Z'
Actual Plan
1st Rotated Plan
Actual Elevation
1st Rotated Elevation
FORMULAE
tan Δ = c/a ; cos φ = h/j ; tan β₁ = e/d ; h² = a² + c² ; β = β₁ − Δ ; cos α = cos φ cos β
CALCULATION TABLE FOR PIPE BEND ANGLE
True lgth. of OB
True lgth. of OA
(Arithmetical Difference)
NOTE: When c = 0, h = a, Δ = 0, and β = β₁.
I ALIGNMENT OF BOLT HOLES AT FLANGE B'
sin θ₁ = cot α tan β
II ALIGNMENT OF BOLT HOLES AT FLANGE A'
CASE 1: O and A in same horizontal Plane – Actual Condition
sin θ₂ = sin β / sin α
CASE 2: O and A in different horizontal Planes – Actual Condition
Actual Plan
2nd Rotated Plan
Actual Elevation
2nd Rotated Elevation
(Arithmetical Difference)

Calculations for pipe bends and standard pipe flange alignment are simplified by this table

also been tabled since these lengths are required to determine the two pipe center-to-face dimensions between *OA* and *OB*.

The original solution concerns itself with pipe bends only, and the scope of the tabled form covers conditions occurring in piping systems. These conditions normally result in the draftsman's being able to obtain directly from drawing information or field information all dimensions shown on the general view. It is often well to consider one of the elevations as the plan. Where conditions prevent obtaining these dimensions directly, they may easily be computed. Also, under normal piping conditions the expression $\beta_1 - \Delta$ is always considered positive. Under an academic condition where lines *OA* and *OB* both slope down (or up) from point *O*, consideration should have to be taken to insure the proper value of β. (When θ is required, the sign of this expression, which merely indicates in which quadrant *OB* is located after rotation, affects the direction of rotation of θ.)

Summarizing, the solution of the general problem by this method consists of solving for at most three angles by the simple right triangle method and multiplying the cosines of two angles. There are no special formulas from which to choose.

Locating Bolt Holes in Flanges

When a flanged joint occurs in either line *OA* or *OB*, it is usually necessary to make at least one of the flanges lap joint or field welded in order to line up the bolt holes. By the use of the calculations on the lower half of the accompanying table, the flanges may be welded and the bolt holes correctly located in the shop. Note that where *O* and *A* are in different horizontal planes the use of the formula $\sin \theta_2 = \sin \beta \div \sin \alpha$ is abandoned, and the original problem is recomputed so that line *OA* may always be rotated in the plane of the paper. The work is shortened because the angle α is already known. The actual plan at the bottom of the calculating table is the same as that at the top, except that *OB* and *OA* have been rotated through the angle ϕ_1.

The development of the detail at

the top of the calculating table indicates the method of determining the direction of rotation of the "straddle center line." For flange A' in case 1 the detail must be rotated about OA' to cause B' to assume its actual position. For flange B', the detail must be rotated about OB' in a direction so that when the detail is rotated about Y-Y', OA' assumes its horizontal position. The same process applies for flange A' in case 2. The development of the detail demonstrates the fact that once the detail has been rotated about the line OB', no amount of rotation about Z-Z' can change the location of the bolt hole "straddle center line." Consequently, for θ_1 and θ_2 in case 2, it is only necessary to base the calculations and determinations of the directions of rotation on the rotated views. For all rotations, θ is opposite in sign to the angle of rotation of the detail.

Derivation of the formula $\sin \theta_1 = \cot \alpha \times \tan \beta$ was accomplished by rotating the detail $A'OB'$ about axis OB' until point A' was at a distance below the original horizontal plane $A'OB'$ so that when the detail was rotated through the angle β about a horizontal axis through B' and perpendicular to OB', OA' would be in a horizontal plane.

Derivation of the formula $\sin \theta_2 = \sin \beta \div \sin \alpha$ was accomplished by rotating the detail $A'OB'$ about axis OA' until point B' assumed the distance below the original horizontal plane $A'OB'$ that determined the angle β.

In the foregoing paragraph two different expressions were obtained, both of which contained a function of β and α and one of which contained a function of ϕ. By equating these two expressions and simplifying, the expression $\cos \alpha = \cos \phi \times \cos \beta$ was obtained.

These expressions may also be used in issuing shop instructions for two or more such bends in the same detail. One bend should be detailed "in the flat" and the other in whatever way it projects. On a section, the angle the projected tangent of the latter bend makes with the horizontal may be computed by solving for θ_1 and θ_2 for the appropriate bends and either adding or subtracting the one to or from the other.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Angelo Patri Stresses the Importance of School Ventilation in Newspaper Column

SOMETIMES school people are so earnest about their responsibilities that they forget the children altogether and center their minds on the mechanics—that is the programs, bells, routines, schedules.

Health is the idea for one school head, let us say. He is bound and determined that every child in his school shall have a sound body because sound minds dwell in sound bodies (sometimes). And what happens?

So much time is taken in making physical examinations, morning inspections, visits to the medical and nursing rooms, making out cards, signing slips, wedging in lessons, that ventilation is forgotten. Pressure is laid on children, and by the end of the morning session the teacher has a headache, half the class have headaches, and that's no way to go to the lunchroom.

There's a long line in the lunchroom and those that come later, being held to the last minute so that the harassed teacher can get in a few last words, reach the counters when everything is about eaten up. "Well, why don't you get here early?" demands the serviceman.

This is not unusual. This picture of tired, pressured, oxygen-starved, food-starved children will be found correct in more schools in this child-loving land than we would like to own.

Not the fault of the teachers—but the blind concentration of the administrators upon the mechanics of the school program to the exclusion of the best procedure for the children.

There is just one cure for most school failings and that is the simple rule, "The children come first." They come before any rule or regulation.

They come before any set course, any fixed program. No matter how good the intention, how sound the rule, it is harmful unless it is of direct aid to the growth of the one child it touches.

It is far more important that fresh air enter a classroom than that all the fingernails are inspected. If both things cannot be done at the right time, attend to the ventilation first, let the nails wait.

The courses of study are for the children, not for the board of regents, not for the boards of education, not for the teachers, not for the parents, not for anybody but the one by one children concerned.

Take this simple fact. Children of a foreign parentage are likely to learn the language of their parents easily.

Then why not allow them to take that language instead of another?

Why force them to take the one language that the state board picked out on the basis of habit or tradition?

We will all do better by ourselves and the pupils, when we measure everything we do in school by one simple rule. The rule must help each child, else why make it?

This article from Mr. Patri's syndicated newspaper column is published here by special permission of the Bell Syndicate, Inc., and should not be reproduced in any way without their permission.

ARISTOTLE WRITES (Book 7, Chapter 17, of Politica) that "All the motions to which children can be subject at their early age are very useful." If this be true, then it is no more than simple justice that one of the narrow gage sleeping cars that runs out of Mexico City on the first step of the journey to Central America is named "Aristotle." For not in the 2200 years since Aristotle's time has man constructed any device which can impart so many diverse motions as does this narrow gage sleeper on its mountainous roadbed. Unbelievable though it seems, the shaking up process was so severe that the mercury columns were broken in three of the research thermometers and by morning the trousers which had been arranged on a hanger had long since fallen out into the aisle; this latter difficulty was easily repaired, however, for after a moderate number of rings on the porter's bell, he appeared with a huge armful of assorted clothing—the problem being reduced to the mere task of selecting one's own trousers.

Train trips are likely to be particularly diverting experiences if one gets off of the main trunk railroads. There is, for example, the line which runs one train a day but has difficulty due to wrecks occasioned by tomorrow's train catching up with yesterday's. Then, too, one can usually expect a certain number of delays due to what are euphemistically referred to as "miscellaneous stops." Four times within the last few months we have been delayed by such stops. The first was due to a washout of a bridge. The engineer was evidently dubious as to the strength of the temporary structure and we made a "miscellaneous stop" to empty a second class coach, then experiment by sending it alone as a "flying switch" to test the structure. Not until one has crossed such a makeshift structure and listened intently to the shrieking and wailing of timber supports does one truly appreciate steel trusses.

The second delay could have been serious but, fortunately, was only amusing. Because the second class coaches are very crowded and the climate very hot, the most highly prized coach seats are on window sills; one sits on the sill with feet inside and the back of the head braced against the inside of the raised window; the weighty parts of the body are allowed to remain outside. On a hot September night south of Hermosillo one of the coach passengers, whose speed and agility had gained him such a choice seat, had the misfortune to go to sleep, momentarily lower his head, and go plunging out into the darkness. For a brief interval he wasn't missed, but at last the alarm was sounded and the train backed a half mile or more in search of him. When found, the unfortunate adventurer was dazedly rubbing a badly bumped head, but it seemed to us that the punishment inflicted on him by friends—in good-natured, congratulatory backslapping—must have in itself been sufficient to induce a concussion if he did not already have one.

Riding another night train down near Suchiate, on the Guatemalan border, a sudden stop was occasioned by loss of some vital piece of the locomotive's entrails. Not less than a hundred passengers joined the search for the lost piece of machinery. With lanterns, flashlights, candles, and even matches, the multitude thronged back along the roadbed with much song and laughter and the ever-present cheerful company of the tropical fireflies which inevitably appear in the evening.

The fourth "miscellaneous stop"

By F. W. Hutchinson

Associate Professor of Mechanical Engineering
University of California

BEHIND THE DRY RESEARCH REPORT SUMMARIZING FACTUAL DATA AND PRESENTING QUALIFIED CONCLUSIONS OFTEN LIES A WARMLY HUMAN BACKGROUND OF INTEREST NOT SO MUCH TO ENGINEERS AS ENGINEERS, BUT TO ENGINEERS AS PEOPLE. THIS MONTH WE TRAVEL TO CENTRAL AMERICA. THE SKETCHES ARE BY KAY HUTCHINSON

occurred on a mainline and can be attributed to the war. A pump had broken down at an out-of-the-way watering stop so a stalled engine of a freight train was allowed to "borrow" water from the passenger locomotive; since this occurred near the town of Tequila, few of the passengers were at all perturbed by the delay.

Our first visit in Guatemala City was to the office of an engineer who represents an American company. There is something indescribably satisfying about a large rocking chair when it finds its way into a business office. In one corner of this man's office was a desk and a straight-backed chair, but the greater part of the room was given over to two large and very comfortable rocking chairs surrounded by an inviting ring of blue and red flowered china spittoons. No Elbert Hubbard mottoes in this office! If the day isn't long enough for both work and friends, well one or the other must wait until tomorrow —and surely, it would be discourteous to ask friends to wait so long!

The impression one gets in Guatemala is that American resident engineers are likely, as a rule, to be rather skillful politicians while the Guatemalan political officeholders not infrequently are found to be surprisingly acute engineers. For example, on a problem involving the transportation by night of subcooled cases of frozen meat on railroad flat cars, it was much easier to persuade the local mayor than the engineer that the cases should be painted soot black, rather than aluminum, to increase the radiant loss to a clear nocturnal sky. The mayor's office, by the way, was one of the few places in Guatemala where we observed employees punching time clocks.

A Guatemalan friend, who is an outstanding engineer, told a curious story that reflects some of the unusual difficulties which beset the technical man in a country where a substantial portion of the population believes that modern conveniences do not justify compromising with long-standing personal feuds or prejudices. Through one section of the city parallel water mains run six blocks apart and it is the obligation and burden of the householder to pay for such branch piping as is needed to connect his house with the nearest main. A group of 14 new residences had recently been constructed on a street two blocks away from the main and an engineer from the water company was dispatched to address a meeting of the home owners and explain to them that the cost of connections would be a minimum if one trench were dug and a larger pipe line installed in place of the 14 small lines (in 14 individual trenches) which would otherwise be necessary.

No dissenting voice was raised at the meeting, but the following morning one of the owners appeared at the company office and asked to talk with the manager. "Senor," he said, "you were most considerate to send the engineer to talk with us and I am deeply grateful for his kindness in trying to save me my money. But I want a separate trench and a pipe line that will be entirely my own. You see, my neighbor is not a good man and we do not care to have dealings with one another. Therefore, it would displease me to drink water from his pipe line just as he too would not enjoy bathing in water from my pipe line. It is true that his water and my water must flow through the same line for the great distance from the reservoir to the branch, but in those early stages of the trip the water is company property and hence does not concern us. But after the branch, a part of it is my property and that

"I shall have a separate trench."

part I wish to keep free from the water of others. Therefore, Senor, but with thanks for your wish to help me save my money, I shall have a separate trench and a separate line; this also you will find to be the wish of most of my neighbors."

The hazard of incorrect correlation is always great, but to the engineer who is interested in the relationship between air conditioning and health, Guatemala offers one particularly interesting set of experimental data. From the time of the Spanish Conquest until the great earthquake of 1918, most buildings erected in or near the capital were characterized by very heavy construction. As in Mexico —consider, for example, the Dominican convent at Tepozteco—the walls were not infrequently 3 ft or more of solid masonry. As a result of the very high thermal capacity of such structures, the influence indoors of outside diurnal tempera-

". . . prized coach seats are on window sills."

ture changes was very small and in consequence the occupants lived in a relatively uniform environment even when no heating plant was installed in the structure.

Following the destruction wrought by the earthquake, construction methods are said to have changed entirely so that subsequent buildings were structurally light and of very low thermal capacity—stucco and sheet iron replaced stone. In such buildings the inside air temperature closely followed the outside and the lack of a heating system was found very noteworthy on cold nights. It is said that the health of the people—particularly as reflected by a high tuberculosis mortality—was extremely low during the 1918 and 1930 period.

Since 1930 brick construction with walls averaging around 13 in. has come into wide favor and general use, so the influence of high thermal capacity is once again definitely noticeable. It is said that a marked improvement in health has resulted from return to the use of heavy walled structures. While no selected or controlled data are available and hence the suggested correlation indicated here between health and thermal capacity is hardly more than idle conjecture and common opinion, nevertheless the possibility of such a relationship existing is sufficiently intriguing—and reasonable—so that one can only hope that some of Guatemala's engineers may find time to investigate more thoroughly and to either establish or disprove the health vs. thermal capacity hypothesis.

On the road from Guatemala to Salvador we travelled with a driver who undoubtedly was as nerveless an individual as one can imagine. Since the mountain roads, the continuous hazard of straggling animals, and the demands of an ancient vintage Hupmobile were not sufficient to occupy his attention, he had obtained a set of six toy animals and installed them on a small flat shelf which was attached to the windshield directly in his line of vision. The toys were not merely inanimate replicas—far from it! Each animal was constructed with internal weights, springs, and balances so that at each rut in the road or acceleration of the car the elephant's trunk would sway ponderously while the giraffe's long neck would move—like a windshield wiper—up and down across the driver's field of vision. Here was a man who could not be disturbed or distracted by a mere half-dozen wriggling, pulsating, swinging gadgets; unfortunately, his passengers were not equally placid and after eight hours of riding each movement of the elephant's trunk had an annoyance coefficient comparable to a piercing and persistent scream.

WE INVITE YOU

to submit short articles on operation, maintenance, repair, alteration or extension of heating, piping, or air conditioning systems in plants and large buildings for publication in HPAC. Regular rates are paid for all such material accepted for publication

But when night came the zoo was scarcely visible; mere silhouettes against the windshield. Then it was that a light switch was pressed and a miniature illuminated shrine, complete with patron saint and auxiliary figures, came into view beside the rear mirror. We were sincerely appreciative of the guidance and protection afforded us by the saint, but could not help but marvel at the difficulty of the task imposed upon him.

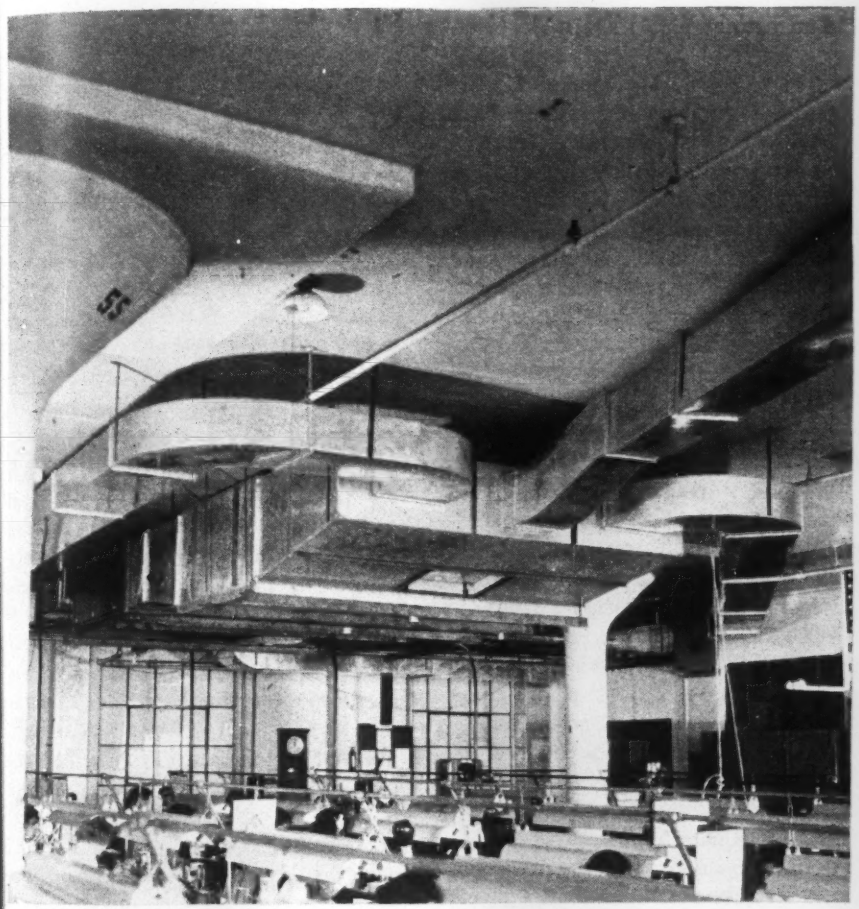
At Salvador, two working days were lost as a result of discovering a 6 in. tropical seed pod beautifully balanced by Nature so that when released it would revolve rapidly, lowering the seed to the earth with only moderate velocity. The pod was aerodynamically perfect and represented such a precise example of single blade propeller design that the temptation to ponder a rational procedure for analyzing its motion was irresistible. Recently the United States Army has announced a similar single blade propeller unit, based on the same principle, for use in "parachuting" a 60 lb pack to the ground.

But time and space in writing of research are more restricted than when working on research so we shall not write of Honduras except to urge the visitor to see the replica of the Copan ruins which is in the Concordia at Tegucigalpa and to urge him to eat heartily before flying through the rough air that frequently surrounds the capital. Similarly, Nicaragua will be passed over with no more than a mention of the view of a tropical sky as seen through openings in the ceiling of a room in the Douglas MacArthur Hotel in Managua, and Costa Rica visited only to the extent of commenting on the brilliantly colored solid wooden wheels of the bullock carts which are everywhere in the country.

So the project is at an end and we return to our hotel half an hour before train time in order to obtain the briefcase full of data sheets which has been stored in the check room. Once on the train our trouble will be over as reservations have been obtained for all subsequent connecting transportation through to Berkeley. Just 30 minutes and the work will be over. We thank the clerk for many courtesies, produce the check for the briefcase, and wait hopefully while the bellboy stares solemnly at the number on the check. "But Senor," he says, "surely you do not want this article tonight?" We tell him of our regret for causing him the inconvenience but indicate that we do want it tonight and that the interval to train time has now been reduced to a mere 20 minutes. After what seems a timeless interval of soul-searching, our friend (all people of Indian ancestry seem to dislike speaking of unpleasant things) returns the check to us and adds, "You see, Senor, the housekeeper has the only key to the storeroom—for greater safety, you understand—and today, being Sunday, she has gone to the early show at the Insurgentes. It is said that there is a very good program. She will not return before two hours." Then, with a radiant smile, "But, Senor, that is long for you to wait. Perhaps—if you hurry—it would be possible for you, likewise, to attend the show!"

By Irving Krushel
Phosphor Preparation Laboratory
North American Philips Co.

ELECTRONIC TUBE CHEMICALS NEED CLEAN AIR



ACCURATE CONTROL of atmospheric conditions is very important in laboratories where luminescent materials are prepared. This is especially true of phosphors that are to be used for cathode ray tube screens. In such tubes, luminescent materials convert the energy of fast moving electrons into light. These inorganic crystalline substances are able to convert electrical energy into visible radiation more efficiently than any other substance. The efficiency, color, and phosphorescent characteristics of most luminescent materials result from the presence of certain desirable impurities in the crystal structure of the phosphor. Thus, a double manufacturing problem exists—to exclude unwanted impurities and to retain desired ones.

Impurities have always been the bane of phosphor research and development. For a long time, newly-prepared phosphors reported in scientific journals defied duplication by other experimenters. At that time, the function of the impurity was not known and, consequently, results varied a great deal. When the function of the impurity as an "activator" was finally understood, its importance was apparent. With this new understanding, spotless laboratories were provided for phosphor manufacture. Even today, phosphor laboratories rarely produce two batches that are exactly alike—they frequently differ slightly in luminous characteristics.

Some phosphors are affected only slightly by impurities. However, some of the important ones are affected drastically by an impurity as small as one part in a million. Uncontrolled impurities in phosphors betray their presence through their effect on brightness and efficiency; they also affect color and phosphorescent characteristics. Obviously, such rigorous purity requirements make dust in the air a critical factor—it must be eliminated in a phosphor laboratory.

Mechanical and Electrostatic Filters

At the Dobbs Ferry, N. Y., factory of North American Philips Co., the laboratory for manufacturing and developing phosphors is completely closed off from other manufacturing sections. All air passing into this laboratory is mechanically and electrostatically filtered. The electrostatic filter is operated at its maximum efficiency by keeping the air flow at an optimum level. At this level, the efficiency of dust removal exceeds 90 per cent as measured by the "black-

Impurities have always been the bane of phosphor research and development. Clean air is needed in laboratories where these chemicals, which are used for cathode ray tube screens, are manufactured. Television and other fields demand the best that electronic tube manufacturers can produce, and the tube manufacturers in turn need clean air

ness" test of the National Bureau of Standards. A portion of the air leaving the laboratory is recirculated through the electrostatic filter, which further decreases the amount of dust in the air in the working section. Furthermore, a positive pressure (slightly higher than normal atmospheric) is maintained in the phosphor section. Thus, air is being forced out continuously through cracks and crevices, and this avoids sucking in any dust or dirt.

The factory laboratory is beyond the wall on which the clock is mounted in the accompanying photograph. The cathode ray tube gun assembly is manufactured in the room shown.

The chemical operators in the laboratory wear special lint-free clothes which are donned in a small double-door chamber adjoining the main manufacturing section. Operators do not come in contact with the chemicals and containers are covered at all times. Equipment used for phosphor preparation is of glass, glass-lined, or ceramic construction. Such materials have little or no effect on the phosphors being prepared. The water used is distilled to a degree where it approximates that of conductivity water in purity.

The Manufacturing Process

Since the amount and kind of impurity determine luminescent characteristics of phosphors, the task of manufacturing such substances becomes one of obtaining the purest chemicals available (usually the chemically pure grade). They are then repurified until the remaining extraneous material does not affect luminescent characteristics to any detectable degree. The purifications are adaptations of well known chemical reactions keeping close control on the final purified substance. Spectroscopic examination shows when poisoning impurities have been eliminated completely.

Purified material is then "activated" by the addition of a minute amount of a desired chemical—this step, in effect, adds an impurity to the pure material. The purified and activated material is then heated to a temperature of about 900 to 1200 C for a period of 1 to 2 hr, depending on the phosphor being prepared. The material grows as it is heated. As crystals of the phosphor are formed, the impurity moves into place in the lattice structure. The size and shape of phosphor particles are very much affected by the heat treatment. Color, efficiency, and phosphorescent characteristics of the finished product are, to a great extent, determined by this operation.

The cathode ray tubes in which these phosphorescent chemicals are used are playing an important part in the war and they will have a prominent role in the peacetime years to come. Television and other fields will demand the best that electronic tube manufacturers can produce.

[*Concluded from Page* 129]

leaving the boiler (neglecting the small heat losses of the valve and pipe bend surfaces). At point *1*, however, the total energy of the steam is only available in two energy forms—pressure and heat. Leaving the bend at point *4*, the velocity energy will increase and the pressure and heat energy will drop accordingly. Striking the pipe wall at point *5*, the velocity is considerably reduced in the jet, stationary waves are formed, and heat as well as pressure is regained through the impact. The extent of this pressure and corresponding heat regain is somewhat difficult to calculate. In the author's opinion, based on similar tests conducted by Stodola, a pressure regain near to the pressure level passing through point *4* may be expected without discharging back into the boiler house. In a closed pipe, certainly, considerably higher pressure regain could take place provided that such pressure increase is caused by the back pressure prevailing at point *5*.

The problem is: Is any pressure increase by passing the interval between point *4* and point *5* permissible without discharging steam back into the boiler house? Tests could clarify the picture; however, I think that it can be assumed that hardly any pressure increase between point *4* and *5* may be permissible without back discharge.

Considering all this, it should be advisable to suggest that a pressure drop of 5 to 6 psi is a safe margin between points *4* and *5* and this may be suggested as a criterion for avoiding blowback conditions.

The critical reader will have observed that the development of the Fanno curves is based on the assumption that the whole heat content developed by internal friction is transferred into velocity or is changed back to increase the enthalpy. This is not fully correct because the loss due to the Joule-Thomson effect is disregarded. The temperature drop due to the Joule-Thomson effect is 12-18 F per 100 psi and therefore for a few pounds friction loss negligible. In any event, it would affect both curves and the method will be still exact enough for determining the pressure interval between points *4* and *5*. Some objection might also be raised regarding using the equation and $pv = RT$ for determining the points of the Fanno curve; however, other equations of state are much too complicated for engineering calculations. If a large diagram of the temperature-entropy type containing volume curves is available, the procedure is simplified.

For computing the correct vent pipe diameter, we are mainly concerned to find the pressure difference between point *4* and point *5*. The location of the other points is of only theoretical interest. This method, therefore, represents a rational and certainly exact enough method which can easily be handled by the designing engineer to determine with enough safety margin the vent pipe diameter.

[Author's note:—I realize that in such a short article not all the questions related to this problem can be discussed. It seems especially difficult to make this method completely understandable in the space available and without a numerical example. A second article is planned. The formulas and diagrams of the present article will then be repeated together with a numerical example. In Fig. 3 some numbers and letters are entered which will be used in the second article.

Between point *4* and point *5* the steam travels in the form of a jet. This problem has been carefully studied, especially in recent years. It is so complex that it requires an article for more extensive treatment. The discussion of this problem would, however, justify my assumption that 5 to 6 psi may be considered as a *safe* margin for the bridging of the interval without blowing back steam into the boiler house.]

NAVY WANTS METHOD OF

Welding High Pressure Piping Without Using Backing Rings

AMONG A LIST of "desirable inventions" which would aid the prosecution of the war that was released by the Navy Department last month and published in the newspapers is a method of welding high pressure piping without the use of backing rings (sometimes called chill rings).

According to H. J. Petersen, chief mechanical design division of the Tennessee Valley Authority, who was asked to comment on this matter by HPAC's editors, "the prime purpose of backing rings is of course to prevent welding beads or icicles from forming inside the pipe. These particles would eventually be carried along the line by the steam, with consequent damage to the valves and turbine blades. Backing rings are generally used in making field joints because of the difficulty in grinding and cleaning the inside of a welded joint at the site. However, joints located within an arm's length of the end of a pipe and which can, therefore, be reached for cleaning, are sometimes made up without backing rings. Conversely, few shop welded joints are made up with backing rings because most shops have turbines or other equipment with which to clean out the inside of a welded pipe assembly.

"A secondary—and, oftentimes, very valuable—use for backing

rings is in the field alignment of the pipe. With well designed rings it is very easy to line up the pipe, making the welder's task relatively easy.

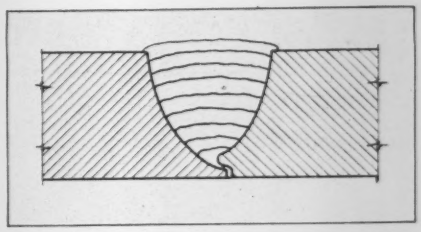
"A third advantage of backing rings," says Mr. Petersen, "is that it is easier to make a weld using a ring. The welder has a positive backstop for his first few passes, which enables him to work at a faster rate. This is offset to some degree if the ring is too heavy, necessitating excessive heating to prevent chilling the first layers of the weld.

"The chief disadvantage of backing rings is that they are expensive," Mr. Petersen continues. "There are numerous designs for rings, most of which require either upsetting of the pipe walls or machining of the pipe ends. This slows down production and costs money. Some designs reduce the inside area of the pipe which is, of course, undesirable. Also, unless the backing rings are well designed, the joints are difficult to assemble in the field, defeating the second advantage noted above.

"Another disadvantage of backing rings is that a careless welder may fill up the pocket formed by the ring and the two pipe ends without obtaining proper fusion between all these parts. This is especially true if the ring does not have a close fit to the inside of the pipe.

"From the above you will note that I believe that there is something to be said on both sides of the question," says Mr. Petersen. "A well designed ring, which requires no special machinery for preparing either the ring or the pipe ends, may prove advantageous for field welding when all factors are considered.

"If a method of welding high pressure piping without the use of backing rings can be developed without sacrificing the advantages



Sketch showing section through pipe weld, suggested by Mr. Petersen, which should not be too expensive to make in the shop and which would allow field welding of the joint without requiring the use of backing rings

of backing rings it will be a very desirable forward step in the art of welding piping joints. I have not given this subject much thought because I believe the various pipe fabricating concerns who maintain engineering organizations are better qualified to analyze this problem. However, the accompanying sketch shows a suggested section through a pipe weld which should not be too expensive to make in the shop and which will allow field welding of the joint without the use of backing rings," Mr. Petersen concludes.

H. N. Boetcher, of the Consolidated Gas Electric Light and Power Co. of Baltimore, was also asked by the editors to comment on the same subject, and says that he is afraid that he is prejudiced in the matter. "I could not say much beyond the arguments I gave in a short paper published in the November 1939 issue of Heating, Piping & Air Conditioning for avoiding the use of backing rings," he continues. "As far as the 'Westport joint,' referred to in that paper, which does not employ a backing ring, is concerned, our experiences with it have gone beyond expectations held at that time. All of the high pressure piping for 245,000 kw capacity in our stations, with well over 1200 large welded joints, was installed using this joint. Experiences were so good—

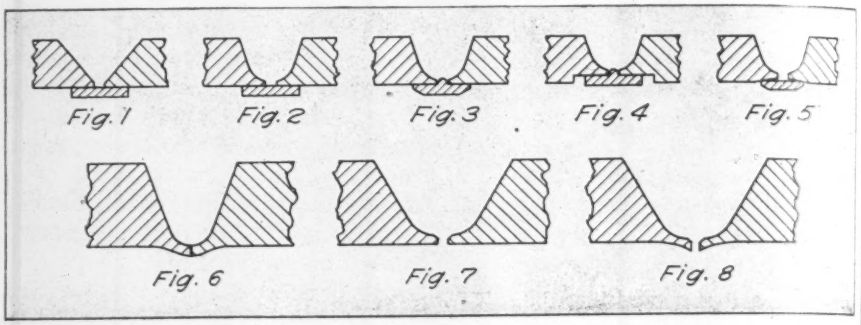
The Navy Department recently issued a list of desirable inventions which would aid the war effort, among them being a method of welding high pressure pipe without the use of backing rings. Here are some comments on the matter. Your views will be welcome for publication. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago

technically and commercially—that we now are using it for medium as well as high pressures, with wall thicknesses of about ⅜ in. being an economic minimum limit. The ASME boiler code committee, after first granting special permission for use of the joint in piping under its jurisdiction, now has amended the code to permit it generally.

"As far as we are concerned, the problem of a joint without backing ring has been solved," he says. "I have called the attention of the National Inventors Council to the joint and understand that several other people, independently, have done the same.

"Others have tried to solve the problem by making the backing ring an integral part of the pipe at one side of the joint," Mr. Boetcher concludes. "This, to me, seems to eliminate only part of the difficulties and introduces others, in return. This design is based on an integral backing ring forming a ledge for the mating end of the next length of pipe and should not be confused with the design shown by Fig. 6 of my paper in the November 1939 HPAC, which, as far as I know, has been discontinued."

These sketches are reproduced from Mr. Boetcher's article in the November 1939 issue of Heating, Piping & Air Conditioning. Figs. 1 to 5 show various pipe joints with separate backing rings, and Fig. 6 illustrates a joint design involving an integral backing ring. Figs. 7 and 8 show two types of the "Westport joint" for pipe



The Safe Storage of Coal

By the safe storage of coal is meant storing coal in such manner that it will not spontaneously heat and catch on fire. Inefficient burning of coal is a waste of much of its heat value, but a fire in the coalpile is a dead loss. When the coal is in a building basement, there is the added risk of serious fire and asphyxiation of those working near.

It is most difficult to put out a fire once it is well started, so that thought should be given to this matter before the coal is stored. When the principles of an approved method are understood, the procedure will be apparent.

Coal Oxidizes

Coal starts to oxidize the minute it is taken out of a mine. Even though this oxidation is slow, it generates heat. If air can circulate freely around the coal, this heat is carried off and nothing happens. But if the coal is covered up so the heat is retained, the temperature goes up and then the oxidation proceeds just a little more rapidly. Soon it gets so hot that coal gas is driven off, and if not detected, a fire follows.

Two Rules to Follow

It will be obvious from this that there are two rules to be followed —first, either store fine coal (2x0 or under) packed down so hard that air cannot penetrate the pile to produce oxidation or, secondly, store nothing but coarse coal, such as nut, egg, or lump, so that air can circulate freely and keep the coal cool. If mine run is to be stored, see that the fine coal is distributed between the large lumps so as to keep air pockets from forming inside the pile.

Keep Trash Out

Before putting coal in the basement, be sure that there are no steam or hot water pipes running through the coal bin so that they come in contact with the coal. Keep all trash, oily waste, rags, old lumber, or anything else that would burn, out of the coal; and never pile the coal so that it comes in contact with hot boiler walls.

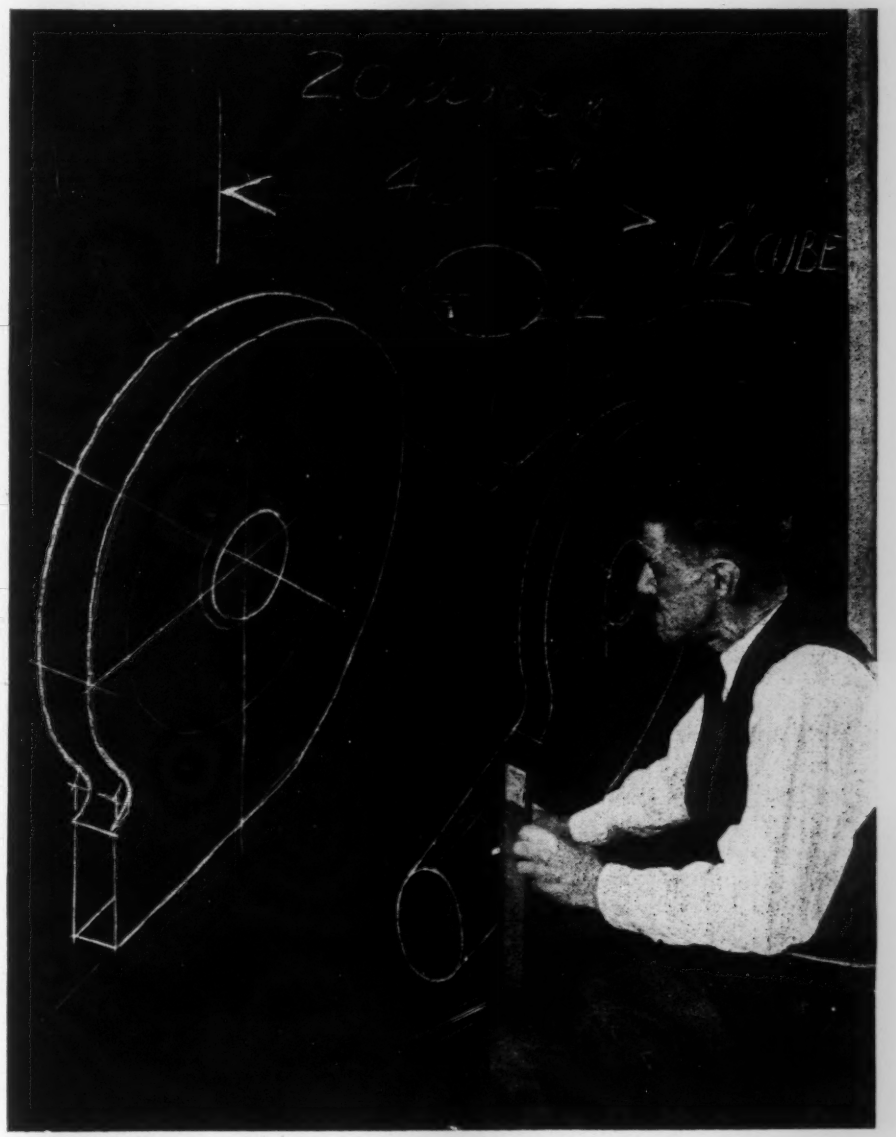
The Bureau of Mines, coal producers, and others have published instructions on outdoor storage of coal.—JOSEPH HARRINGTON, advisory engineer, Northern Illinois Coal Corp., in a letter distributed to aid the National Fuel Efficiency Program.

RAILROAD AIR CONDITIONING

"You might be surprised, but I have had railroad engineers tell me that when air conditioning is cut into operation that it is just like adding from one to two more cars on the train for the engine to pull. Thus, you can see the importance of keeping the weight down to a minimum and having efficient drive equipment," said J. A. Bucy, of the B. & O., in a talk on railroad air conditioning at a meeting of the ASRE in Washington last fall.

Perspective and Orthographic Drawing

By V. L. Sherman



Isometric blackboard used for experimental sketches in the development of designs at the engineering department of the Petersen Oven Co. The isometric lines are marked with a scratch-all; they are hardly visible in the photo but are visible to the designer because of imbedded chalk dust. Long diameter of 12 in. is shown by architect's scale taped to blackboard. This illustration serves also as a portrait of the author, V. L. Sherman

DR. THOMAS E. FRENCH, probably the best known of all authorities on engineering drawing, is the author of a complete entry on that subject in the Encyclopedia Britannica. The present writer urges anyone at all interested in the subject to study the six pages with care. In this article, "isometric" comes under the heading "one plane projection." In the same edition the entry on perspective drawing is written by W. H. Lawrence of Massachusetts Institute of Technology. The 10 pages of intriguing and beautifully illustrated material opens with a paragraph on isometric drawing, which "should never be confused with true perspective." We certainly agree to this.

What's in a Name?

In Webster's New International Dictionary, "isometric" is referred to and illustrated under the title "axonometric projection." There are, also, "trimetric," "one point," "two point," "three point," and "diagonal" perspectives, and "oblique" and "cabinet" perspective float somewhere in the background as abortive expediencies. It is not the notion here to quarrel with the vocabulary, but the field appears obscure and some suggestions may be in order. Just as in our creeds we can be "orthodox" or "unorthodox," so in our engineering drawing we might use "orthographic projection" or "unorthographic projection." And it might be suggested that unless perspective is "true perspective" it actually is "orthographic projection." We agree with that statement, although, as shown in Fig. 1, the "parallel perspective" (as we used to call this type of sketching and isometric) does not look like orthographic projection.

There are 132 terms listed in the dictionaries beginning with the prefix "ortho." The meaning—normal, correct, perpendicular—is quite evident. So the terms orthographic projection or orthographic drawing seem to be just and reasonable. If, however, a drawing cannot be readily identified as orthographic the present writer will say it is perspective, and let it go at that. Castigation is expected.*

Fig. 1 shows four sketches in "parallel perspective," and attempts to show that in this type of sketching the construction is just as mechanical or geometrical as in any

*See "Open for Discussion" in this issue.

orthographic projection. In Fig. 1a, the vertical center line was drawn first, and a horizontal long diameter marked for the first ellipse. The diameter, 1 5/16 in., is a true diameter. The short diameter of this ellipse is chosen to give the desired elevation of observation. The ellipse was drawn freehand. (It should be stated that ellipses are easy to draw after a little practice, but the more nearly they approach the form of a circle the less easy they become.)

Next, the center line sloping down to the left was put through the center. This line is the center line of the damper pin. A tangent to the ellipse is drawn where this damper pin passes through. Placing the tangent is not so difficult, either, but if one hesitates, a couple of points equally distant from the point on the ellipse can be marked as shown and a line drawn through these points. The tangent is parallel to this line. This construction is ordinary geometry.

Parallel to the tangent another line is drawn through the center. At right angles to this center line, a long diameter is drawn at the center and an ellipse of 1 5/16 in. diameter sketched in. This ellipse must pass through the damper pin holes. The damper can be turned to a closed position as indicated by the arrowed elliptical arc. The long diameter of this ellipse is the same, 1 5/16 in. There are now three ellipses representing three circles perpendicularly placed.

If there is a definite height to the cylinder the true height can be measured off on the long radius, as at *0-3*. Then the line *3-4* is drawn parallel to the line *1-2*. This foreshortening will give the correct height of the cylinder for the sketch.

The sketch of Fig. 1b is nearly self explanatory. Vertical sections taken through the two ellipses on the vertical and horizontal center lines give the four points determining the ellipse at the joint.

In Fig. 1c a vertical length of pipe is met with another section at 120 deg. The vertical position on the vertical ellipse is marked at *0-1*. This point, *1*, is projected to the circle at *1'*. Measuring from *1'*, the 120 deg and the bisector at 60 deg are marked on the circle and projected back to the ellipse, *2'* to *2*, and *3'* to *3*. *0-2* gives the direction of the center line of the lower section of pipe, and *0-3* the position of the intersection.

In Fig. 1d a perpendicular intersection of equal diameter pipes shows how elements can be as easily handled in perspective as in orthographic drawing. The sketch is incomplete so as to avoid analytical complications in the first attempt.

Contrast Between Perspective and Orthographic

Fig. 2 is an attempt to contrast the usefulness of perspective with that of orthographic in visualization. Here we cut a right cone to form a parabola. The plan, front view, and true shape of the parabola are shown, but an analysis of the parabola in these views is somewhat difficult to associate with the cone from which it is cut. The base of the cone and the circular section above it with inscribed right angle triangles appear in the plan and front views as well as in the perspective, but are not so easy to associate with each other.

By geometric construction (in the perspective sketch)

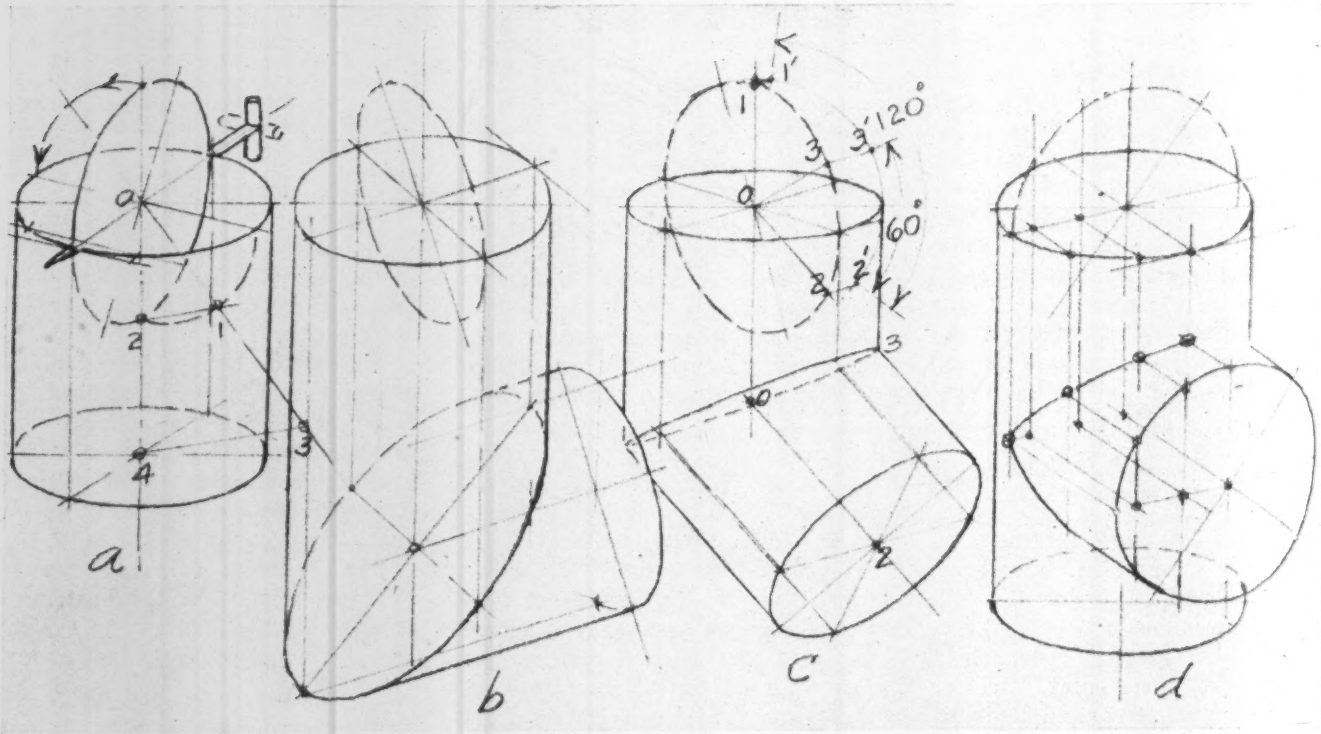
$$\frac{a}{y}=\frac{y}{b} \quad \left| \quad a=\frac{y^2}{b} \right. \quad \left| \quad \frac{A}{Y}=\frac{Y}{B} \right. \quad \left| \quad A=\frac{Y^2}{B} \right.$$

According to geometric construction a is always equal to A. Therefore

$$\frac{y^2}{b}=\frac{Y^2}{B}, \text{ or } \frac{B}{b}=\frac{Y^2}{y^2}$$

Since $B/b = X/x$, then $X/x = Y^2/y^2$; or the fall in the parabola is proportional to the square of the distance away from the axis.

Fig. 1—Sketches showing "parallel perspective" laid out at any chosen angle or pitch



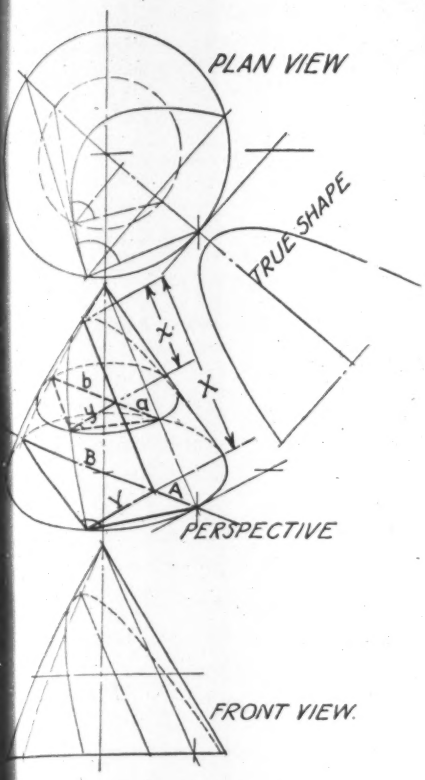


Fig. 2—Perspective conic section in contrast to orthographic projection

The writer has enjoyed "playing" with conic sections and other geometric figures in perspective. Some of the strange equations—that is, strange to the beginner in geometry—are cleared up well under perspective analysis.

Shortest Connection Between Two Pipe Lines

Fig. 3 is brought in to discuss orthographic and perspective a little further. Given the plan and front views with a pair of pipe center lines *A* and *B*, drawn in at odd angles, the problem is to find the shortest connection. It is just as well this problem is rare, but there are others of the same type that are common. In Figs. 3a, 3b, and 3c are shown perspectives of the three planes of projection. In succession they resemble the end cuts of a joist, a common rafter, and the seat cut of a jack rafter. But in each case the points in the problem must be projected only at right angles to the planes of projection. The projection in the larger figure, as indicated in Fig. 3c, is absolutely no different. It is strictly according to the rules of orthographic projection.

This problem can be handled with a higher degree of accuracy, if the dimensions are great, in a full-scale isometric on a blackboard such as is shown in the accompanying photograph than it can be on a small scale projection drawing.

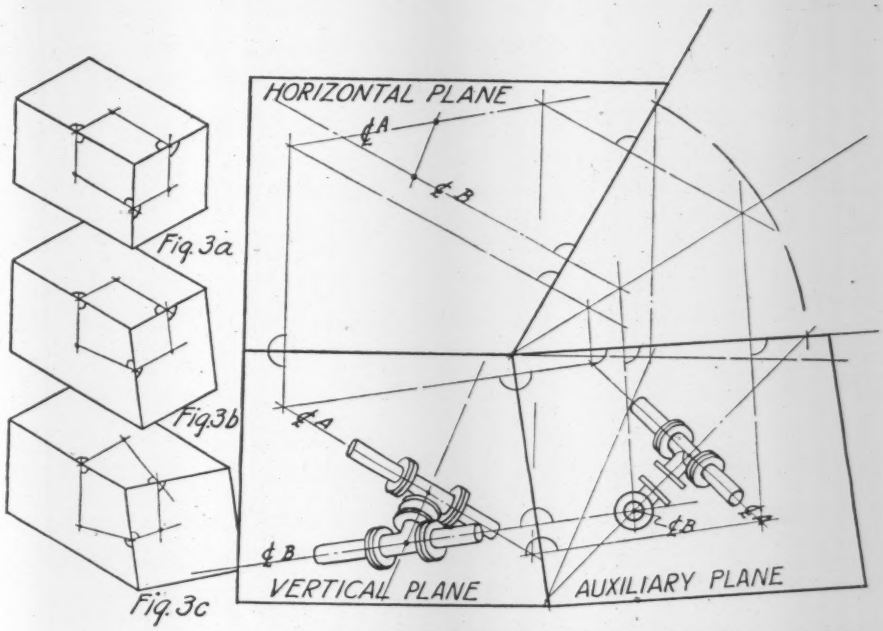


Fig. 3—Determining shortest connection between center line *A* and center line *B*. This is strictly orthographic projection

There's Fuel Value in Exhaust Steam

Every power plant in which there are steam engines or pumps for any purpose has an exhaust steam problem. The heat energy taken out of the steam as it comes to the engine is much less than the energy in the exhaust. Obviously, therefore, the appearance of steam being dissipated into the air is an indictment of the management and a challenge to prove that a loss so apparent cannot be avoided.

Rarely is it necessary to have more than 5 psi pressure in the heating system of a building, no matter how large. The exhaust steam from the engine can, therefore, be used directly in the heating system. This also applies to many processes, such as laundering and cooking.

Apparatus is available by which high pressure steam can be mixed with the very low pressure steam, and a pressure developed adequate to produce the necessary circulation in the system. Thus the valuable energy is recovered and much fuel saved.

Water for any service such as lavatories, showers, laundries, boiler feed, and manufacturing processes, can be effectively heated by exhaust steam. The water formed by condensing the steam can be removed from the heater by a simple trap, and if free from oil, returned to the boiler or other receiver for reheating and recirculating.—JOSEPH HARRINGTON, advisory engineer, Northern Illinois Coal Corp., in a letter on fuel efficiency distributed to aid the National Fuel Efficiency Program.

* * *

The outlook for civilian users of gasoline and home heating oil was described last month by Petroleum Administrator Harold L. Ickes as one of extreme gravity. He said that supply and demand were just about in balance "on paper," but that various factors—notably an upsurge in military requirements or intensified transportation trouble—could quickly upset the balance.

The current stringency along the Atlantic seaboard, Deputy Administrator Ralph K. Davies pointed out, is not due to an overall lack of gasoline but to transportation tie-ups.

Sam Lewis' Page

In this regular feature, informal comment on heating, piping, and air conditioning problems is given each month by Samuel R. Lewis, consulting engineer, and a member of HPAC's board of consulting and contributing editors. This month, he answers a query from the maintenance superintendent of a theater on installing convectors.

THE SUPERINTENDENT of maintenance in a theater writes as follows:

"At one of our theaters two convector type cast iron radiators were installed. They were recessed in pockets in the wall so that the fronts of the radiators were flush with the wall. There were no grilles. The plumber had these radiators, and the piping, the valves, etc., all covered with plaster, faced across the recesses. Thus, in order to move a radiator, tighten a union, or replace a radiator valve it will be necessary to break open the wall or plaster. The contractor claims that this is good piping practice. I heartily disagree. May I have your opinion?"

In comment, I wonder if the gentleman who buried the convector type radiators was a plumber or a steamfitter? Plumbers get blamed unfairly far too many times, but they are taught to conceal the water and waste pipes of their interesting trade. Maybe the chap who buried the convectors in the theater wall was trying to emulate the panel heating scheme of the British Embassy in Washington. Perhaps he is a follower of my own ideas about the wall hung convector and agrees with me that it would be better to bury it, provided that there is enough of it, than to permit it, in the conventional manner, to pump dust from the floor to be deposited on the wall.

Warm plaster makes an excellent heat transmitter. No radiation is needed in the hotel room that has on one side of it the warm wall of the chimney. Intelligent is the designer of a skyscraping building who can keep the chimney outdoors or certainly away from the walls of tenant spaces.

Experience demonstrates that relatively large, low temperature, heat transmitting areas are preferable to small, very hot, heat transmitters. Outstanding economies in fuel have been demonstrated by steam circulating systems that operate at pressures and corresponding temperatures far below atmospheric.

Editor's note—A copy of Mr. Lewis' above comment was sent to the superintendent of maintenance, and he replied as follows:

"Thank you very much for Mr. Lewis' material in answer to my question regarding convector radiators. I enjoyed reading it and in the main agree with him. But it seems to me that Mr. Lewis has buried the answer I want, along with the convectors.

"The idea that the 'chap who buried the convectors' had panel heating in mind is purely coincidental. It seems to me that since there were no grilles, in order to conceal the exposed piping, he had the convectors and the piping plastered over.

"Generally in panel heating where piping is inaccessible certain practices are employed to eliminate the possibility of leaks, such as welding joints and fittings, using wrought iron pipe, etc. But in this case since panel heating was not intended we still have the possibility of having to remove a radiator, tighten a union, or replace a valve. Certainly the advantage of not having 'dust pumped into the wall' does not balance the expense involved in having to break and replaster in order to make some repair to the convector.

"This is the question I would appreciate an answer to. Is it generally good practice to lock or plaster over any piping or radiators so that repairs cannot be made without breaking the wall, and leaving no room for expansion?"

Editor's note—Mr. Lewis replies further:

I am accused of being an undertaker, in that when I commented on the plastering-in of the thermally circulating convectors I buried the answer that our correspondent sought.

I would enjoy shooting any contractor who buries pipes or radiators or convectors. No intelligent or experienced steamfitter will imbed steam or return pipes in an inaccessible location such as within a concrete floor. If he acts as undertaker for heating system pipes in earth or sand or cinders, eventually and soon the pipe will leak, and a boiler may be damaged or the owner may be put to heavy expense for replacing the pipe.

Corrosive influences working from inside the pipe are bad enough, without having a mortician invite favorable conditions for similar action to occur outside the pipe. It is almost always possible by exercise of a little ingenuity to avoid burying pipes, and the undertaking should be sidestepped, even though to do so may mean radical changes in the type of heating system. If any pipe must be placed under a floor that rests on the ground the pipe should be enclosed within a watertight encasement such as vitrified tile, and the tile should have a manhole at each end that permits inspection and detection of leaks.

We have frequently changed from steam to mechanically circulated hot water so as to avoid return pipes below ground story radiators.

If pipes are to be imbedded in floors or walls, as for radiant heat transmission, the pipe material certainly should be warranted for long endurance, and all buried joints should be welded or sweated. These radiant pipes should never be imbedded directly on concrete but may be below a concrete floor in thoroughly drained crushed stone or gravel, in my opinion.

It is never good practice to plaster over radiators or convectors or pipes that have threaded joints or that are so buried in the masonry structure that expansion cannot occur. Always there should be means for inspection and repair of such heating apparatus without tearing out the walls. Where welded ferrous pipes are employed in radiant heating there should be accessible valves on the equipment serving each room so that in case of need any reasonable division of the system can be isolated.

There is reason to believe that use of a liquid heat carrier such as water will result in longer life of radiant heating pipes than if a complex gas such as low pressure steam is employed.

Air Conditioned Spiders on War Job*—To insure a better U. S. bombsight, refrigeration engineers recently provided specially air conditioned living quarters for a race of pampered spiders in a war plant. Reason: Spiders' webs make the best cross hairs for bombsights, and to keep the insects spinning contentedly the year 'round, they must have controlled climate.

Hurricanes in a Vacuum*—Manufactured hurricanes roaring through a near vacuum at 70 below zero are now helping to make U. S. warplanes safer in the skies over Berlin and Tokio. The man-made wind travelling at 600 miles an hour is created inside a mammoth tunnel at Wright field where research engineers have made it possible to produce a stratosphere on earth with vacuum pumps and tons of refrigeration.

*Above items are from the York Corp.

Individual Heat Control Is Provided in Several Large Apartment Projects

By R. M. Balch, Jr.

SOME APARTMENT construction has been authorized in certain localities where housing facilities are particularly critical, and in some cities incompleted or skeleton structures have been allowed to be completed; a number of apartment buildings, too, have been modernized to provide more smaller dwelling units . . . Mr. Balch, who is sales manager of the apartment controls division of the Minneapolis-Honeywell Regulator Co., describes a few apartment building projects here, where individual heating control allows each tenant to maintain the temperatures suitable for his own use

ALTHOUGH APARTMENT building construction has been frozen generally, some apartment construction has been authorized in certain localities where housing facilities have been most critical. In other cities skeleton or incompleted structures have been allowed to be completed and also a number of apartment buildings containing large suites have been allowed to modernize, in order to provide more smaller apartments to accommodate more family units in the same space.

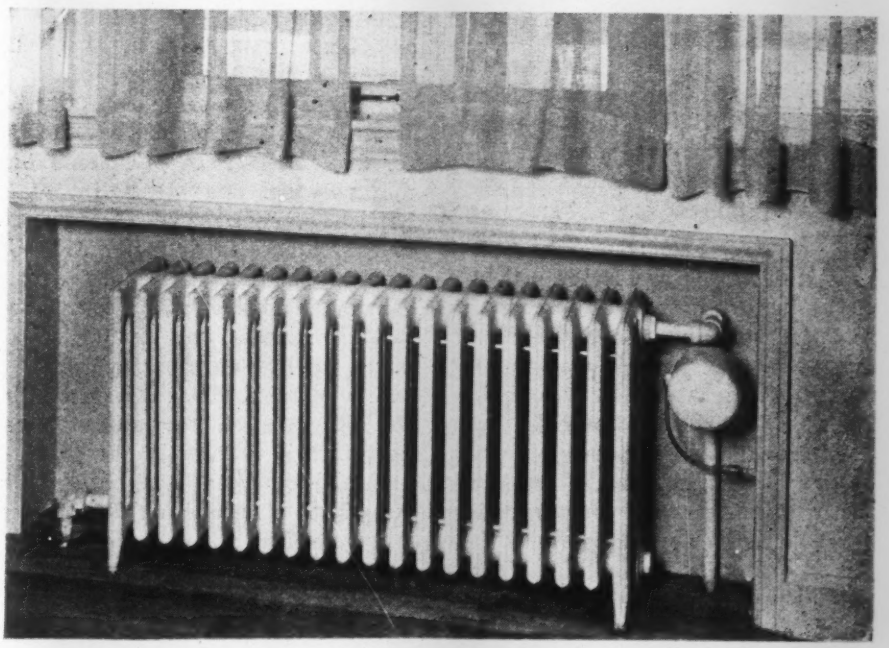
In Hartford, Conn., West Hartford Village is being completed—a unit consisting of five groups of three buildings each and providing a total of 72 apartments. A central heating plant supplies hot water heat distributed by a two pipe system. A pneumatic thermostat in each apartment actuates individual motorized pneumatic radiator valves so that temperatures may be held at temperature levels according to the individual tenant's desires. An additional feature is a compensated hot water control which automatically varies the water temperature in the heating system. An outside controller bulb changes the aquastat setting on the boiler so that in extreme weather, water is heated to about 180 deg and in milder weather water temperatures may be reduced to about 120 deg. A pump in the system operates continuously, providing hot water at all times at the radiator valves.

On the plot for this first unit, space is provided for 14 more groups of buildings to contain 170 more apartments. Authorization for this further construction is expected by the spring of 1945. General contractors for the project are F. H. McGrew Co., and the architect is Willard Wilkins. Officers of the building corporation plan to use this same system of heat control throughout the entire project.

In Kansas City, Mo., an apartment building has stood unfinished, in skeleton shape, for the last six years. This 10 story structure, on Armour Blvd. at Gillham, was taken over by Herman Shapiro and with the assistance of HOLC, the building has been completed. A total of 133 one and two bedroom apartments are equipped with a system of individual apartment heat control. A two pipe vacuum steam system is in operation in the building. Each apartment is equipped with one thermostat which actuates motorized radiator valves. Each tenant is able to adjust his temperature to his requirements.

A similar skeleton structure is expected to be finished soon, to provide living accommodations for another 100 or more families in Kansas City's crowded war worker community. The A. D. Jacobson Plumbing and Heating Co. installed the system of individual apartment temperature control.

Cleveland, Ohio, has had a tremendous expansion and resultant serious housing shortage, due to extensive war industries. Also, due to the location of so many industries on or adjacent to the lake front, WPB has allocated a large percentage of housing units to be apartments rather than small houses. Here, during 1944 and 1945, a total of 11 apartment buildings are to have personalized heat control. These buildings will contain a total of 494 suites, mostly one and two bedroom size. All of these buildings are the "garden"



A pneumatic thermostat in each apartment actuates radiator control valves

A thermostat in each apartment allows temperatures to meet the individual requirements of the tenants

or two story type of construction, except one 100 apartment structure and one 156 apartment building. Final plans are not yet complete for these larger "elevator" type apartment buildings. The largest of these structures is to be on Euclid Ave. adjacent to the downtown section of Cleveland. Location of all of the garden type apartment buildings is in Shaker Heights or bordering on this suburban section.

Hot water is the heating medium to be used in the smaller two story buildings. A one pipe system of distribution is being installed. Two pipe steam is planned for the two large structures. All of the individual heating controls installed so far in Cleveland have been applied to the one pipe hot water systems. Each of the individual apartments is to have one pneumatic thermostat located in the living room. This instrument will respond to the individual setting of each tenant. All radiators, except in baths and kitchens, are being equipped with individual pneumatic radiator valves.

It is sometimes desirable to include the hand radiator valve besides the automatic valve on bedroom radiators so that they can be shut off independently at night if the occupant wishes, in the cases where there is only one thermostat controlling all of the radiation in the entire apartment. In these cases, if the hot water system of heating is used, it is necessary to have a drilled port in the valve seat, allowing a certain amount of hot water to pass through the radiator at all times to prevent freezing at night.

It is desirable to provide a thermostat with a high limit setting so that the tenant cannot set the thermostat higher than a reasonable normal temperature—for example, 74 F. Experience, however, has proved that this is not necessary, as practically all tenants are perfectly satisfied when temperatures are held at a comfort level and the tenant definitely does not raise windows and then set the thermostat high, as this creates a drafty and uncomfortable living condition the same as it would in a house, where this practice is certainly not done.

The majority of these heating systems is being installed by the Spohn Heating and Ventilating Co. Prominent builders and owners in this construction work are Charles Bernstein and Herbert Shepherd of Shepherd-Keyes & Truehaft.

Pipe Thread Standards

A joint U. S.-Canadian screw thread mission recently conferred in London and was reported in Industrial Standardization, journal of the American Standards Association. A proposed revision of the American Standard for Pipe Thread, B2.1-1942, was presented to the conference for consideration as a basis of unification, Elmer J. Bryant, chief engineer of the Greenfield Tap and Die Corp., stated. The British delegation offered a number of comments on this proposal and mentioned that British standard pipe threads up to four inches in diameter are extensively used on the continent of Europe. Considerable confusion would result if any change were made in British Standard Specification No. 21, they declared. On the other hand, for sizes above four inches, in view of the considerable production in the United Kingdom of American Petroleum Institute Line Pipe threads, on oil country goods, with which the proposed new American Standard for Pipe Thread is now in line, it was considered that the use of the British specification might be discontinued in due course. With this possibility in mind, it was agreed that the British would consider the formulation of a standard for these larger sizes based on the American Standard. It was also agreed that the possibility of coordination of the American and British Specification for the four-inch diameter and smaller should be pursued.

Conserve Fuel by Heating Efficiently!

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

C.-E. A. Winslow
New Haven, Conn.
President

Proceedings of the 51st Annual Meeting

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Hotel Statler, Boston, Mass.
January 21-24, 1945

(Concluded from February Journal Section)

First Session—Monday, January 22, 2 p. m.

IN HIS OPENING remarks at the first session of the 51st Annual Meeting of the Society, Hotel Statler, Boston, Pres. S. H. Downs, Kalamazoo, Mich., stated that the Society had suggested an international meeting for the purpose of standardizing psychrometric data and that the first meeting of this group would be held during the annual meeting in Boston. He read a radiogram from the *Institution of Heating and Ventilating Engineers* of Great Britain as follows:

> CONGRATULATIONS ON FORMATION OF INTER-SOCIETY COMMITTEE. BEST WISHES FOR SUCCESS OF BOSTON MEETING. REGRET REPRESENTATION IMPOSSIBLE. HAVE APPOINTED CORRESPONDENT. IHVE TABLES PRIMARILY CONFORM WITH BRITISH AIR MINISTRY METEOROLOGICAL OFFICE PUBLICATIONS. CORDIALLY OSCAR FABER.

Following the Reports of the President and of the Council (published in the February 1945 Journal Section) President Downs called upon Treas. L. P. Saunders, Lockport, N. Y., for his report, which was followed by the report of the Secretary.

Report of the Treasurer

The Society is in strong liquid financial position. All investments are now in Government funds, this being accomplished during the past year. Management of the Society is more concerned with the program than finance. Appreciation is to be acknowledged for the assistance of Dr. B. M. Woods, chairman of the Finance Committee. The total assets of the Society $142,359. General Fund (ten-month period) $42,482. Reserve Fund $54,855. Endowment Fund $25,378. F. Paul Anderson Fund $1,021. Permanent Building Fund $7,351. A total matured value of bonds $123,300. Market value $99,809. Research Fund $27,381.

Respectfully submitted,
L. P. SAUNDERS, *Treasurer.*

Report of Secretary

The first half century of the American Society of Heating and Ventilating Engineers has just passed into history and only two members have been privileged to participate in its activities for the full span of 50 years and one of them is here with us today, Mr. Homer Addams.

This fiftieth year has been notable in that it marks the high point of Society membership and the election of the

greatest number of members in a single year. The number of Chapters now is 37 with five chartered this year by the Council. Great credit is due the Membership Committee for its work, under the able leadership of M. F. Blankin. The current status of membership is:

Membership Status as of January 1, 1945

Charter Members	2
Honorary Members	2
Life Members	93
Members	2146
Associates	1315
Juniors	272
Students	25
Total	3855

A special word of praise should be given to the Admission and Advancement Committee for its painstaking efforts in processing over 750 applications and grading the applicants.

It is difficult for any member to visualize the great amount of detail work that must be done to elect a member under our rules. After receipt of an application and until election there are 10 steps to be taken that involve writing not less than 10 letters, making an abstract of the application, and sending out 40 forms and ballots, filling in 10 record cards and making over 50 entries in our books and records. In total there must be communication with at least 30 people during the election period. Although there is record of many studies by committees to simplify the procedure, there can be little accomplished without changes in the Constitution and By-Laws.

The report of the Finance Committee will give some clue to the work necessary to handle the financial affairs of the Society under the various funds set up to operate general activities, research and special projects. Reserves were adjusted to meet the Constitutional requirements of October 31, 1944, as directed by the Finance Committee. In general, operating expenses have been held within the budget provided and income exceeded estimates.

The extent of the work of the Technical Secretary is reflected largely in the reports of the Guide Publication Committee, the Standards Committee and the Publication Committee, which are responsible for compiling the Guide text, codes and standards, and publication of meeting and other technical papers.

With the expansion of research and other technical committee activities, the increase in membership and many wartime restrictions that have been encountered there has been a heavier load placed on the headquarters office staff and this was carried on without adding to the staff, although there have been numerous changes in personnel amounting to 40 per cent.

New equipment had to be obtained for office records and the plan of establishing a uniform system for chapter records was completed this year.

There was close cooperation with the Chapter Relations Committee in handling some of the details of chapter speaker assignments, and arrangements were made for the official visits of officers to all chapters.

Some of the highlights of the year's activities have been mentioned, but it would be impossible to give a complete account of all the details which must be handled at the headquarters office.

All routine actions required by the Constitution and By-Laws have been taken with regard to membership, finances, publications and committee activities, and many special assignments have been undertaken as required by the Council.

It is a distinct pleasure for me to say to you that all of this could not have been accomplished without the full cooperation and loyalty of my associates on the staff who met the heavy demands of an unprecedented volume of work with commendable spirit and effective teamwork.

In closing one of the most successful years in the Society's history your Officers can recall with great personal satisfaction that the 50th Annual Meeting was a notable gathering which focused attention on *our great past* and pointed the way toward *a greater future.*

All who had a part in carrying on the Society's work during this 50th year appreciate the honor, and I am very glad to acknowledge the helpful assistance and cooperation of the Officers, Council, Committees, and Chapter Officers during this year.

Respectfully submitted,
A. V. HUTCHINSON, *Secretary.*

Accountant's Report

Tusa & La Bella
Certified Public Accountants
52 William Street
New York

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS,
51 Madison Avenue,
New York, N. Y.

Gentlemen:

Pursuant to your request, we examined the books of account and records of the American Society of Heating and Ventilating Engineers—New York, N. Y., and the related funds for the fiscal year ended October 31, 1944, and submit herewith our report.

The audit covered a verification of the assets and liabilities as of the close of business October 31, 1944, and a review of the operating accounts for the period then ended. For the period audited the recorded cash receipts were traced into the depositories; the cancelled bank checks were inspected, compared with the cash records and supported by payment vouchers; also the dues income and interest income from savings accounts and securities were accounted for.

A Balance Sheet reflecting the financial condition of the Society as of the close of business October 31, 1944 is submitted herewith and your attention is directed to the following comments thereon:

CASH

Cash on Deposit was verified by direct communication with the commercial and savings banks listed in the attached schedule of cash and the balances reported to us were reconciled with those shown by the books of the Society.

Checks representing the Cash on Deposit were inspected by us and the Petty Cash counted.

MARKETABLE SECURITIES

The securities, shown on the subjointed schedule, were verified by direct communication with the Bankers Trust Company, where same are deposited for safe-keeping. This asset has been included in the Balance Sheet at the cost of acquisition plus the accumulated and accrued interest earned thereon.

CERTIFICATE OF INDEBTEDNESS

The Certificate of Indebtedness issued to the Society by Farrar & Trefts, Inc., was verified by inspection of the instrument.

The installments and interest on this indebtedness are being paid as due.

ACCOUNTS RECEIVABLE

A trial balance of the membership dues receivable was taken as of the close of business October 31, 1944. The unpaid dues were classified as to class of membership and aged as follows:

Members	$1,951.50
Associates	1,190.50
Juniors	90.00
Students	19.00
TOTAL	$3,251.00
Dues invoiced during 1944	$2,772.00
Dues invoiced during 1943	72.00
Dues invoiced during Prior Years	407.00
TOTAL	$3,251.00

We also took a trial balance and classified and aged the Miscellaneous Accounts Receivable which follow:

Guides	$1,374.57
Transactions	9.00
Books and Reprints	12.05
Emblems	2.50
TOTAL	$1,398.12
Charges made during October, 1944	$ 849.49
Charges made during September, 1944	128.22
Charges made during August, 1944	103.25
Charges made Prior to August 1, 1944.	317.16
TOTAL	$1,398.12

The reserves for doubtful dues and miscellaneous accounts receivable, as adjusted, in our opinion are ample to cover probable losses that might result in the collection of the same.

INVENTORIES

The emblems on hand were counted by us, and the inventories of paper and Transactions were verified by communication with printers. These inventories were priced and computed by us. The following Transactions were reported to us:

Volume	Year	Quantity	Price	Amount
Prior	Prior	1350	$1.00	$1,350.00
45	1939	139	1.66	230.74
46	1940	74	1.25	92.50
47	1941	43	1.32	56.76
47	1941	150 (unbound)	.96	144.00
48	1942	9	1.42	12.78
48	1942	150 (unbound)	1.07	160.50
			TOTAL	$2,047.28

PERMANENT ASSETS

Furniture, Fixtures and Library are shown herein at the book values without appraisal by us. We did, however, provide for depreciation of furniture and fixtures at the rate of ten per cent per annum.

DEFERRED CHARGES

We have deferred to future operations one-sixth of all the subscriptions paid to H. P. A. C., since the payment of same are on a calendar year basis and the fiscal year of the Society ends on October 31.

ACCOUNTS PAYABLE

All purchase invoices found on file that were applicable to the operations of the current fiscal period were listed and the proper liability therefor reflected in the attached Balance Sheet.

TAXES WITHHELD

The sum of $1,085.06 represents taxes withheld from employees on salaries paid during the month of October, 1944 and the additional compensation set up as of October 31, 1944.

DEFERRED INCOME

The prepaid dues, classified as to membership, follow:

Members	$ 365.65
Associates	359.50
Juniors	99.15
TOTAL	$ 824.30

The above prepaid dues by elected members as well as the dues prepaid by candidates for membership in the additional sum of $393.13 are reflected on the attached Balance Sheet as deferred income.

RESERVE FOR PUBLICATIONS

In accordance with provisions made both in the 1943 and 1944 budgets, we have reserved the sums of $3,400.00 and $3,500.00, respectively, to cover the publication of Transactions, Volumes 49 and 50.

FUNDS

An analysis of the following Funds reflecting the changes that occurred in these accounts during the fiscal year ended October 31, 1944, is included herein:

General Fund
Reserve Fund
Endowment Fund
F. Paul Anderson Fund
Permanent Building Fund

The Permanent Building Fund was created by virtue of the following resolutions which were adopted at the Council meeting of October 16, 1944:

"That in accordance with Article B-xi, Section 8 of the By-Laws, that the reserve fund shall be increased to an amount equivalent to $15.00 per member as of October 31, 1944, by transfer of money in the General Fund to the Reserve Fund."

"That the amount of Initiation Fees in excess of the sum required to meet the requirements of the By-Laws for the Reserve Fund as of October 31, 1944, be allocated to the Permanent Building Fund."

The contributions to the said Permanent Building Fund during the fiscal year ended October 31, 1944, follow:

Initiation fees collected during the fiscal year ended October 31, 1944		$6,355.00
Amount of Reserve Fund in excess of $15.00 per member as of October 31, 1944		186.61
Contributions made by:		
New York Chapter	$561.06	
Western Michigan Chapter	249.27	810.33
TOTAL		$7,351.94

There is included herein a complete financial report as prepared for the Committee on Research setting forth the financial position of the Research Fund as of the close of business October 31, 1944, and the results from operations for the fiscal year then ended.

During the current fiscal year a final liquidating dividend of $6.86 was received from the Bank of U. S. in Liquidation, leaving a balance of $145.67 which we have written off to the Endowment Fund Account.

Respectfully submitted,
Tusa & LaBella (Signed),
Certified Public Accountants.

Dated December 27, 1944.

BALANCE SHEET

American Society of Heating and Ventilating Engineers—
New York, N. Y.
October 31, 1944

ASSETS

GENERAL FUND				
CASH				
On deposit		$21,522.73		
On hand		100.00		$21,622.73
INVESTMENTS (AT COST)				
Securities (Market Value $23,095.00)		22,900.00		
ADD: Accumulated interest	$1,050.00			
ADD: Accrued interest	105.00	1,155.00		24,055.00
CERTIFICATE OF INDEBTEDNESS				92.45
ACCOUNTS RECEIVABLE				
Membership dues		3,251.00		
LESS: 40% for Research	1,256.80			
LESS: Reserve for doubtful	500.00	1,756.80		
		1,494.20		
Advertisers and Sundry debtors	1,398.12			
LESS: Reserve for doubtful	100.00	1,298.12		2,792.32
INVENTORIES				
Transactions—Copies	2,047.28			
Transactions—Paper	411.11	2,458.39		
Guide Paper—1945		2,217.18		
Emblems		384.25		5,059.82
EXCHANGE				6.75
PREPAID TRAVELING				
Railroad scrip				24.46
PERMANENT				
Library		300.00		
Furniture and fixtures	2,923.97			
LESS: Reserve for depreciation	1,742.41	1,181.56		1,481.56
DEFERRED CHARGES				
Prepaid H.P.A.C. subscriptions				1,065.64 $56,200.73
RESERVE FUND				
Cash on deposit				3,863.30
Securities at cost (Market value $52,548.00)		50,719.06		
ADD: Accumulated interest	1,790.50			
ADD: Accrued interest	33.75	1,824.25	52,543.31	56,406.61
ENDOWMENT FUND				
Cash on deposit		2,579.41		
Cash on hand for deposit		43.00	2,622.41	
Securities at cost (Market value $22,166.00)		22,005.65		
ADD: Accumulated interest	696.50			
ADD: Accrued interest	53.84	750.34	22,755.99	25,378.40
F. PAUL ANDERSON FUND				
Cash on deposit			8.98	
Securities at cost		1,000.00		
ADD: Accrued interest		12.50	1,012.50	1,021.48
PERMANENT BUILDING FUND				
Cash on hand for deposit			5,800.33	
Due from Reserve Fund			1,551.61	7,351.94
				$146,359.16

LIABILITIES AND CAPITAL

GENERAL FUND				
LIABILITIES				
ACCOUNTS PAYABLE			$ 1,643.64	
TAXES WITHHELD			1,085.06	
ACCRUED ACCOUNTS				
Additional compensation to employees			3,162.34	
DEFERRED INCOME				
Prepaid membership dues	$ 824.30			
LESS: 40% prepaid to Research	290.06	$ 534.24		
Dues prepaid by candidates for membership		393.13	927.37	
RESERVE FOR PUBLICATIONS				
Transactions (1943) Volume 49		3,400.00		
Transactions (1944) Volume 50		3,500.00	6,900.00	
TOTAL LIABILITIES			$13,718.41	
GENERAL FUND			42,482.32	$56,200.73
NOTE "A"—This Balance Sheet is subject to the comments contained in the letter attached to and forming a part of this report.				
RESERVE FUND				
Due to Permanent Building Fund			1,551.61	
Principal		$52,819.49		
Unexpended income		2,035.51	54,855.00	56,406.61
ENDOWMENT FUND				25,378.40
F. PAUL ANDERSON FUND				
Principal			1,008.98	
Unexpended income			12.50	1,021.48
PERMANENT BUILDING FUND				
Principal				7,351.94
				$146,359.16

STATEMENT OF INCOME AND EXPENSES

American Society of Heating and Ventilating Engineers—New York, N. Y.
For the Fiscal Year Ended October 31, 1944

INCOME

INCOME FROM MEMBERS			
DUES—RENEWALS			
Members and Associates	$47,556.00		
LESS. Cancellations	2,792.00	$44,764.00	
LESS: 40% to Research Fund	17,905.60	$26,858.40	
Junior and Students	1,473.00		
LESS: Cancellations	335.00	1,138.00	$27,996.40
DUES—NEW MEMBERS			
Members and Associates	6,925.00		
LESS: 40% to Research Fund	2,770.00	4,155.00	
Juniors and Students		277.50	4,432.50
TOTAL DUES			32,428.90
OTHER INCOME			
Initiation Fees		6,355.00	
Emblems and Certificate Frames		277.45	6,632.45
TOTAL INCOME FROM MEMBERS			39,061.35
INCOME FROM PUBLICATIONS			
Editorial Contract		15,999.96	
Guide Sales and Advertisements—Per Schedule attached		54,013.07	
Sale of Transactions		730.34	
Income from Books, Reprints, Etc.		482.81	71,226.18
INCOME FROM INVESTMENTS			
Interest—Savings Accounts		104.88	
Interest—Securities		456.17	
Interest—Certificate Frames		2.64	563.69
TOTAL INCOME			$110,851.22

EXPENSES

OPERATING EXPENSES			
President's Fund	$ 2,179.10		
Council travel and meetings	2,894.84		
Membership Committee	2,435.65		
Admissions and Advancement Committee	246.04		
Constitution and By-Laws Committee	214.43		
Nominating Committee	64.72		
Chapter Relations Committee—Chapter records	400.76		
War Service Committee	66.15		
Chapter Development Committee	186.50		
Chapter Delegates' travel	2,815.24		
A. S. A. Membership	100.00		
Membership certificates	199.62		
Medals and awards	320.35	12,123.40	
MEETING EXPENSES			
Meetings	3,221.30		
Speakers to Chapters	716.77		
Chapter meeting allowance	900.00	4,838.07	
PUBLICATION EXPENSES			
Members' subscriptions H.P.A.C.	6,294.53		
Guide publication and distribution—Per Schedule attached	48,949.28		
Transactions	3,689.47		
Membership roll	1,599.98		
Standards (including Codes)	33.99	60,567.25	
HEADQUARTER'S EXPENSE			
Salaries—Secretary and staff	21,995.88		
Additional compensation	3,952.93		
Traveling—Secretary and staff	1,160.76		
Rent and light	3,635.62		
Telephone	766.57		
Telegraph	199.62		
Postage	2,158.76		
General printing	971.69		
Office supplies	657.43		
Addressing and address changes	143.30		
Professional services	800.00		
Bank charges	78.98		
Depreciation of furniture and fixtures	292.40		
General office expense	892.68		
TOTAL HEADQUARTER'S EXPENSES	$37,706.62		
LESS: 30% to Guide	11,311.99	26,394.63	103,923.35
NET INCOME			6,927.87
DEDUCT: COUNCIL APPROPRIATIONS			
Initiation fees to Permanent Building Fund		6,355.00	
Special appropriation to Research		10,000.00	16,355.00
EXCESS OF EXPENSES OVER INCOME FOR THE YEAR			$ 9,427.13

STATEMENT OF INCOME AND EXPENSES—GUIDE

American Society of Heating and Ventilating Engineers—New York, N. Y.
For the Fiscal Year Ended October 31, 1944

INCOME			
Guide advertisements	$22,868.25		
LESS: Discounts	518.31	$22,349.94	
Guide copy sales		31,663.13	
TOTAL INCOME			$54,01
COST OF 1944 GUIDE			
EDITING AND PRINTING			
Paper	4,065.56		
Composition and presswork	10,258.04		
Binding	4,170.00		
Mailing, expressage and cartons	666.89		
Engraving and art work	441.44		
Editorial salaries	4,116.04	23,717.97	
ADVERTISING SALES PROMOTION			
Salaries	5,556.62		
Traveling, etc.	1,670.03	7,226.65	
COPY SALES, PROMOTION AND DISTRIBUTION			
Printing, multigraphing, etc.	1,895.29		
Mailing, expressage and postage	4,132.16		
Indexing	77.67	6,105.12	
GUIDE COMMITTEE EXPENSE.		587.55	
TOTAL		37,637.29	
APPORTIONABLE EXPENSES		11,311.99	
TOTAL COSTS AND EXPENSES			48,949.28
NET INCOME FROM GUIDE OPERATION TO RESEARCH FUND			$ 5,063.79

BUDGET COMPARISON—SOCIETY ACTIVITIES

American Society of Heating and Ventilating Engineers—New York, N. Y.
For the Fiscal Year Ended October 31, 1944

INCOME

	Actual	Budgeted	Increases	Decreases
MEMBERSHIP INCOME				
DUES—RENEWALS				
100—Members	$30,071.50	$ 29,930.00	$ 141.50	
101—Associates	14,692.50	17,820.00		$ 3,127.50
102—Juniors	1,100.00	3,200.00		2,100.00
103—Students	38.00	125.00		87.00
	45,902.00	51,075.00	141.50	5,314.50
DUES—NEW MEMBERS				
104—Members	3,639.00	1,980.00	1,759.00	
105—Associates	3,286.00	1,980.00	1,306.00	
106—Juniors	265.00	400.00		135.00
107—Students	12.50	75.00		62.50
	7,202.50	4,435.00	3,065.00	197.50
TOTAL DUES	$53,104.50	$55,510.00	$ 3,206.50	$ 5,512.00
OTHER INCOME				
108—Initiation fees	6,355.00	2,750.00	3,605.00	
109-110—Emblems and Cert. Frames	277.45	50.00	227.45	
	6,632.45	2,800.00	3,832.45	—0—
TOTAL INCOME FROM MEMBERS	$59,836.95	$ 58,310.00	$ 7,038.95	$ 5,512.00
INCOME FROM PUBLICATIONS				
115—Editorial contract	$15,999.96	$16,000.00		$ .04
116—Guide sales and advts.	54,013.07	46,000.00	$ 8,013.07	
117—Sale of Transactions	730.34	600.00	130.34	
118—Income from books, reprints, etc.	482.81	250.00	232.81	
119—Sale of Codes	—0—	25.00		25.00
	71,226.18	62,875.00	8,376.22	25.04
INCOME FROM INVESTMENTS				
125—Interest—Savings accounts	104.88	200.00		95.12
126—Interest—Securities	456.17	750.00		293.83
127—Interest—Cert. of Indebt.	2.64	2.00	.64	
	563.69	952.00	.64	388.95
	131,626.82	122,137.00	15,415.81	
COLLECTION OF PRIOR YEAR'S DUES	4,227.00	2,741.00	1,486.00	
TOTAL INCOME	$135,853.82	$124,878.00	$16,901.81	$5,925.99

EXPENSES

OPERATING EXPENSES				
150—President's Fund	$ 2,179.10	$ 2,500.00		$ 320.90
151—Council travel to meetings	2,894.84	2,500.00	$ 394.84	
160—Executive Committee	—0—	100.00		100.00
161—Finance Committee	—0—	200.00		200.00
162—Membership Committee	2,435.65	2,500.00		64.35

170—Admissions and Adv. Comm.	246.04	150.00	96.04	
171—Constitution and By-Laws Comm.	214.43	150.00	64.43	
172—Nominating Comm.	64.72	150.00		85.28
173C—Chap. Rel. Comm. —Chap. records	400.76	–0–	400.76	
174—War Service Comm.	66.15	1,500.00		1,433.85
175—Chapter Development Comm.	186.50	–0–	186.50	
173B—Chapter Delegates travel	2,815.24	2,300.00	515.24	
201—A.S.A. membership.	100.00	100.00	–0–	
204—Membership certificates	199.62	200.00		.38
206—Medal and awards.	320.35	200.00	120.35	
	12,123.40	12,550.00	1,778.16	2,204.76
MEETING EXPENSES				
163—Meetings	3,221.30	3,000.00	221.30	
173A—Speakers to Chapters	716.77	1,200.00		483.23
327—Chapter meeting allowance	900.00	900.00		
	4,838.07	5,100.00	221.30	483.23
PUBLICATION EXPENSES				
200—Members subscription H.P.A.C.	6,294.53	6,000.00	294.53	
305-326—Guide Publ. and distrib.	48,949.28	44,060.00	4,889.28	
202—Transactions	3,689.47	3,500.00	189.47	
203—Membership roll	1,599.98	1,500.00	99.98	
164—Standards (including Codes)	33.99	150.00		116.01
	60,567.25	55,210.00	5,473.26	116.01
HEADQUARTERS EXPENSES				
210—Salaries—Secy. and staff	21,995.88	21,500.00	495.88	
211—Additional compensation	3,952.93	3,000.00	952.93	
212—Traveling—Secy. and staff	1,160.76	1,200.00		39.24
213—Rent and light	3,635.62	3,600.00	35.62	
214—Telephone	766.57	700.00	66.57	
215—Telegraph	199.62	200.00		.38
216—Postage	2,158.76	1,600.00	558.76	
217—General printing	971.69	900.00	71.69	
218—Office supplies	657.43	600.00	57.43	
219—Addressing and address changes	143.30	200.00		56.70
220—Professional services	800.00	800.00		
221—Bank charges	78.98	50.00	28.98	
222—Depreciation—Furn. and Fixt.	292.40	250.00	42.40	
223—General office exp.	892.68	600.00	292.68	
TOTAL HEADQUARTERS EXPENSES	37,706.62	35,200.00	2,602.94	96.32
LESS: 30% charge to Guide	11,311.99	10,560.00	751.99	
	26,394.63	24,640.00	1,850.95	96.32
INITIATION FEES TO BUILDING FUND	6,355.00	2,750.00	3,605.00	
COUNCIL APPROPRIATION TO RESEARCH	10,000.00	10,000.00		
TOTAL EXPENSES	$120,278.35	$110,250.00	$12,928.67	$ 2,900.32

CONDENSED FINANCIAL REPORT
RESEARCH FUND
Oct. 31, 1944

Assets		
Cash on hand and on deposit		$27,650.02
Laboratory equipment, furniture and fixtures		6,359.53
Prepaid rent		1,325.00
TOTAL RESEARCH FUND		$35,334.55
Endowment Fund		588.06
		$35,922.61
Liabilities and Funds		
Accounts payable and taxes		$ 1,417.86
Unexpended balance of Council appropriation		3,401.95
Deferred income—earmarked projects		2,842.70
Prepaid dues for 1945		290.06
Research Fund		27,381.98
TOTAL RESEARCH LIABILITIES AND FUND		$35,334.55
Endowment Fund		588.06
		$35,922.61

ANALYSIS OF RESEARCH FUND

Balance November 1, 1943		$28,749.54
Additions		
Refund—University of Wisconsin	$1,185.85	
Equipment, furniture and fixtures	6,601.27	$7,787.12
Deductions		
Excess of expenses over income for fiscal year ended Oct. 31, 1944	9,154.68	
NET REDUCTION		1,367.56
Balance Oct. 31, 1944 per balance sheet		$27,381.98

STATEMENT OF INCOME AND EXPENSES
FOR THE FISCAL YEAR ENDED OCTOBER 31, 1944

INCOME

From A.S.H.V.E.			
40% of 1944 and prior years dues collected		$21,503.60	
Special Council appropriation		6,598.05	$28,101.65
Contributions—Per Schedule			
General		$ 4,803.00	
Earmarked		316.75	
Glass Study—balance from prior year		1,088.38	6,208.13
Interest from Bank Deposits			37.63
TOTAL INCOME			$34,347.41

EXPENSES

Chairman and Committee			
Traveling	$ 673.07		
Chairman's Office	102.31		
Professional Services	200.00	975.38	
Research Laboratory			
Salaries—Administrative and Technical	$16,101.83		
Salaries—Clerical (N. Y. and Laboratory)	3,901.33		
Traveling	1,385.87		
Postage	283.82		
Telephone and Telegraph	308.56		
Office Expenses and Supplies	746.13		
Printing and Mimeographing	950.00		
Library and Periodicals	217.30		
Laboratory Materials and Supplies	1,504.61		
Insurance	231.01		
Depreciation—Equipment and Fixtures	340.71		
Unallocated	133.10		
Taxes (Cleveland rent)	1,855.00		
Property Insurance	288.55		
Heating	385.00		
Electricity	86.50		
Gas	12.96		
Water	13.50		
Janitor	516.40		
Building Maintenance	16.48	29,278.66	
Cooperative Research			
University of California	$ 1,600.00		
University of Minnesota	1,200.00		
Case School of Applied Science	2,000.00		
Oregon State College	500.00		
Texas A & M College	250.00		
Cornell University	500.00		
University of Pennsylvania	600.00	6,650.00	
Special Council Appropriation			
Expended part of $10,000.00 Grant		6,598.05	43,502.09
EXCESS OF EXPENSES OVER INCOME			$ 9,154.68

B. M. Woods, Chairman of the Finance Committee of the Council, presented his report.

The Committee had undertaken to appraise the financial condition of the Society and its policies of using its funds with special reference to the future developments in the Society.

Charts had been prepared to show the year by year growth in resources, membership, expenditure and income, and it was the plan of the committee to keep the charts up to date to enable any members to appraise the general condition of the Society.

Dr. Woods presented a slide showing the number of members who joined each year and pointed out that during the last two years the increase in number of members was approximately 1000.

The average age of Society members is approximately 45 years according to another study which had been made.

Employee benefit plans were being considered with reference to the headquarters personnel and laboratory staff.

Careful consideration was being given to the various Society Funds to determine whether they were in such a form that the Society could make desired use of them. Dr. Woods stated that the principal funds were Endowment, Research, and General Funds, and that the use of these funds was subject to the following limitations:

The Endowment can only be invested in U. S. Government securities and only the interest from it may be used by the Society. A constitutional amendment would be required if it were desired to use the fund for the purpose of acquiring a headquarters building or home for the Society.

The Research Fund, according to the Constitution, is to be accumulated to an amount of $15 per member. The Fund, therefore, grows with the membership. Not more

than 20 per cent of the Reserve Fund may be expended in one year and then only for emergency purpose. The Fund must be invested at least one-half in U. S. and Canadian Government securities and the remainder in investments approved by the State of New York for savings banks and trust companies.

The General Fund represents working capital and is in a fluid condition so that it can provide considerable working capital.

Dr. Woods stated that a joint study is being made by the Committee on Research and the Finance Committee of the administrative operation of a plan which will insure a permanent and continuing policy of liberal support for Society Research worthy of the traditions and activities of the Society.

The next was report of the Membership Committee by the Chairman, M. F. Blankin, Philadelphia, Pa. Mr. Blankin stated that in 1943 Society membership had dropped to 3006 members from a peak of 3200 in 1940. A potential membership of 5000 had been considered possible by Mr. Blankin and he had, therefore, inaugurated an energetic campaign to increase membership.

During 1944, 752 new members had been elected and 125 applications were awaiting action by the Committee on Admission and Advancement. Society membership on January 19, 1945, had reached a total of 3938, which represented a 33⅓ per cent increase in two years. Mr. Blankin paid tribute to the activities of members of various Chapters and made special reference to the five new Chapters which had accounted for approximately 250 new members, Central New York, Central Ohio, Denver, Memphis, and Utah.

President Downs suggested that during 1945 the Society could easily reach a membership of 5000.

President Downs then introduced Homer Addams, New York, N. Y., a Charter Member and past president of the Society, and several other past presidents, among whom were, J. F. McIntire, Detroit, Mich., E. Holt Gurney, Toronto, Can., and M. F. Blankin.

L. F. Collins, Detroit, Mich., presented his paper on Studies of the Mechanism of Solution of CO_2 in Condensates Formed in the Steam Heating Systems of Buildings (published in January 1945 Journal Section, *Heating, Piping & Air Conditioning*), and D. S. McKinney, Pittsburgh, Pa., presented the paper Preventing the Solution of CO_2 in Condensates by Venting of the Vapor Space of Steam Heating Equipment, prepared by D. S. McKinney, J. J. McGovern, C. W. Young, and L. F. Collins (published in February 1945 Journal Section, *Heating, Piping & Air Conditioning*).

E. W. Guernsey, Baltimore, Md., presented a written discussion to be published in 1945 Transactions. Dr. Guernsey, basing his comments upon tests conducted for the Consolidated Gas, Electric Light and Power Co., Baltimore, stated that while it might not be practicable to apply venting in all desired places to reduce CO_2 corrosion a thorough knowledge of the factors which influence the entry of CO_2 into condensates would be of value in designing products to minimize CO_2 solution.

These papers, in his opinion, provided additional assurance that the solution of gases in steam heated equipment occurred as would be expected from the application of established principles.

Dr. Guernsey suggested that the cause of an increased solution of CO_2 in some cases was the falling of condensate through regions of higher CO_2 concentration.

P. H. Weitzel, Dayton, Ohio, asked about the generally accepted source of CO_2.

D. M. Hummel, New Haven, Conn., asked whether CO_2 corrosion could be detected by distinctive symptoms.

G. W. Hayes, Boston, Mass., cited his experience in reducing corrosion in return lines from 30,000 sq ft of steam radiation by returning the condensate to a vented receiver. Whereas pipes formerly failed due to corrosion in six years, the piping from the vented receiver to the boilers had been in service 18 years. He inquired whether the author believed the venting of the receiver was the cause of the improvement.

Author's Closure: Mr. Collins in closing the discussion informed Mr. Weitzel that the principal source of CO_2 in steam was the calcium and magnesium carbonate present in the feed water. CO_2 was liberated by the decomposition of the carbonates.

In reply to Mr. Hummel, Mr. Collins stated that while oxygen corrosion usually causes a pitted surface in which there is an accumulation of insoluble deposits, carbon dioxide corrosion is typified by clean, evenly thin surfaces and, in partially filled lines, usually by grooving action along the bottom.

The author felt unable to comment on Mr. Hayes' installation without having more information about it, but did say that under certain circumstances a receiver vented to the atmosphere might introduce oxygen and thereby increase the amount of corrosion.

The author called attention to the word *increase* in line 20 of the 1st column of page 41 of the first paper presented, which should have been stated as a *decrease*.

President Downs thanked the authors and Dr. Guernsey for the excellent presentation and comments and then introduced Prof. E. B. Watson, Ithaca, N. Y., who presented an abstract of the papers Summer Weather Data and Sol-Air Temperature—Study of Data for New York City, by C. O. Mackey and E. B. Watson, and Summer Weather Data and Sol-Air Temperature—Study of Data for Lincoln, Neb., by C. O. Mackey; (data on New York City published in November 1944; data on Lincoln published in January 1945 Journal Sections, *Heating, Piping & Air Conditioning*).

John Everetts, Jr., San Francisco, Calif. (Written): The authors of this paper are to be complimented upon their study and presentation of a subject which has heretofore been quite nebulous and irrational in spite of its importance to the air conditioning engineer.

The effect of solar radiation on an air conditioned space has been guessed at for years. In most cases, the guess has been conservative or the solar radiation load has been small compared to the total load and consequently, the results have not been disastrous.

The only point to which I wish to take exception is the statement attributed to Dr. I. F. Hand, U. S. Weather Bureau, that he believes that solar radiation values for New York City are representative of average large city conditions. This is not true.

From the study of weather data made by Albright* and Everetts† from 1931-1937, it was found that dust and dirt contamination in the atmosphere had little effect upon the solar radiation as compared to the effect of haze and light fog.

A recheck of 12 cities where solar intensities are recorded show the following comparison with New York City taken at a value of 100 per cent:

East: Washington, D. C.—103 per cent; Boston, Mass.—97 per cent; Ithaca, N. Y.—100 per cent; Newport, R. I.—99 per cent; State College, Pa.—104 per cent.

Midwest: Nashville, Tenn.—113 per cent; Madison, Wis.—111 per cent; Lincoln, Nebr.—117 per cent.

West Coast (South): Fresno, Calif.—151 per cent; Davis, Calif.—156 per cent; Riverside, Calif.—134 per cent.

These percentages are based upon the mean solar intensity for the months of June, July, August, and September, and are indicative of a trend based upon factors other than latitude, physical size of the city, and atmospheric contamination.

*Analysis of Summer Weather Data in the United States, by J. C. Albright. (ASHVE Transactions, Vol. 45, 1939, p. 397.)

†Application of Summer Weather Data in Design, by John Everetts, Jr. (ASHVE Transactions, Vol. 45, 1939, p. 431.)

The material contained in this paper is of such importance that I would like to submit two recommendations for consideration by the Society.

1. That the data contained in the subject paper be studied by the TAC on Cooling Load in Summer Air Conditioning to determine the practical value of these data as applied to design.

2. That, if these data are found useful in design, the authors be requested to continue their studies for those cities where solar radiation readings are taken and that the work be done in conjunction with the TAC on Weather Design Data.

I would like to take this opportunity to thank Prof. Mackey and Mr. Watson for their valuable contribution to the Society.

G. V. Parmelee[3], Cleveland, Ohio. (Written): The author's concept of the sol-air temperature has been of considerable aid in the solution of periodic heat flow problems. A single variable now replaces the two variables, outdoor air temperature and solar intensity. The values are dependent upon the assumption of an outdoor air film coefficient which is ordinarily a function of wind velocity. This coefficient also includes the effect of radiation exchange between a surface and its surroundings.

It seems to me that the concept of sol-air temperature might to advantage be extended to include *all radiation* effects. The air film coefficient used would be strictly a function of velocity. The reasoning back of this statement is based upon the fact that the radiation and convective heat transfer are not at all times additive. Study of a paper[4] previously published yields some interesting data. For example, curves were drawn for a 2 in. concrete roof with a smooth asphalt finish. Between the hours of 9:00 p.m. and 6:00 a.m. the temperature difference between the air and the top surface of the roof ranged from zero to one degree, averaging about one-half degree. The wind velocity averaged about 4 mph during this period. The average temperature of the roof dropped steadily one degree or more per hour. Based upon the heat capacity of 6.92 Btu per (sq ft) (degree) as given in a paper[5] published in 1942 on the same subject, heat stored in the roof was being lost at the rate of 7 to 20 Btu per (sq ft) (hour).

During the early part of the period heat was being gained from the outdoor air at the rate of 3 or 4 Btu per (sq ft) (hour) and was lost from the under side of the roof at the rate of 4 to 9 Btu per (sq ft) (hour), while the roof lost stored heat at the rate of 14 to 25 Btu per (sq ft) (hour).

In the last part of this period heat was gained from the room at the rate of 2 or 3 Btu per hour and was lost to the outdoor air at about the same rate. In brief, heat was being lost by the roof at a much greater rate than could be accounted for by application of commonly accepted film coefficients and the measured heat flow rates, because of the large heat loss by radiation to the night sky.

Heat gains in the early morning hours are not of great interest, but performance of a roof or wall during the day is certainly affected by its previous history. Possibly a better agreement between test results and theoretical calculations could be obtained if consideration were given to nocturnal radiation effects. Although the clear night sky is sometimes considered as a black body at —40 F, some experimental work should be carried out to accurately measure the magnitude of this effect.

Victor Paschkis[6], New York, N. Y. (Written): The approximate method described by Mackey and Wright[7] is based on the use of the fundamental harmonic in Fourier's analysis. In simple words, in the approximate solution an equivalent sine wave curve for the sol-air temperature is used instead of the actual curve. As shown by the authors in their appendices A and C this causes an appreciable error: the maximum rate of heat transfer from the inside surface was 25 per cent higher than the actual maximum rate, and the time of the maximum was one hour later than the actual time.

These discrepancies were found for a sol-air temperature as per Fig. 3 of this early paper.

Now the sol-air temperature as per Fig. 1 to 3 of the present paper appears to be less similar to a sine wave than Fig. 3 of the earlier paper. Therefore, it might be expected that the errors due to the approximate method might be larger than those in the original article. It would be interesting if the author in his closure would show to what extent it is still permissible to use the approximate method.

W. H. Carrier, Syracuse, N. Y., expressed admiration of the ingenious use of sol-air temperature but stated that it was of little practical application in many cases because the average difference in load between a sunny and a cloudy day of the same temperature was about 8 to 10 per cent for a building having an average amount of window area. He pointed out that for a room with southern exposure the load including normal lighting load might be about 125 Btu per square foot without sun effect and about 150 Btu (average), for three hours only, with the sun effect. The maximum of 150 Btu would apply to only about one-fourth of the surface. Hence the difference should be divided by 4 to obtain an idea of the sun effect. The sun effect on walls would also be less than on glass.

Dr. Carrier referred to tests made in Detroit for which results had been presented in papers previously submitted to the Society. The tests showed a very small effect from heat transmitted through the wall at the time of peak load. For example, the thermal lag in a 13 in. brick wall was more than 12 hours so that there was a minimum heat transfer through the walls when the transmission through glass from direct sunlight was at a maximum. In the tests referred to, the effect of the heat transferred through the wall at time of peak load was small enough to be neglected.

In rooms used in process work at lower temperatures or in southern climates the heat transfer through the wall might be positive at all times. An analysis of temperatures for Shanghai indicated that the maximum sun effect was equivalent for the entire building of a 7 deg rise in outdoor temperature.

The maximum sun effect would occur in a factory building having a slab roof (usually 4 in. concrete and 2 in. planking), but in an office building its effect would be small except on the top floor. Whatever its effect might be it was nevertheless important to determine the sun effect.

A knowledge of sol-air temperature effect would be of particular value in selecting for a laboratory test room an outside temperature which would be equivalent to the effect of the sun and surrounding air upon any assumed combination of glass and wall area.

Dr. Carrier emphasized the fact established in the paper that the sol-air temperature would be invariable regardless of the indoor temperature or the construction of a wall.

L. T. Avery, Cleveland, Ohio, remarked that engineers should consider carefully the effect of sun load because many air conditioning systems failed because of its effect which normally might equal 279 Btu per square foot for a western window.

C. M. Ashley, Syracuse, N. Y., referred to the value of solar radiation, which at one hour before sundown was 160 Btu per (sq ft) (hr) in New York City and 124 in Lincoln and which is shown as approximately 50 in THE GUIDE. The difference suggested the need for examination of the source of the Guide data. Attention was called to the fact that values on the New York curve were smaller in the morning and larger in the afternoon than for Lincoln.

Authors' Closure: Professor Mackey referred to the method of combining air temperature and solar radiation and stated that they were combined only when they occurred on the same day at the same hour.

The author thanked Commander Everetts for his correction of the quotation from Dr. Hand.

Referring to the comments of Professor Parmelee, the

[3]Research Fellow, Fenn College.

[4]Summer Cooling Load as Affected by Heat Gains Through Dry, Sprinkled and Water Covered Roofs, by F. C. Houghten, H. T. Olson and Carl Gutberlet. (ASHVE Transactions, Vol. 46, 1940, p. 231.)

[5]Heat Gain Through Walls and Roofs as Affected by Solar Radiation, by F. C. Houghten, E. C. Hach, S. I. Taimuty and Carl Gutberlet. (ASHVE Transactions, Vol. 48, 1942, p. 91.)

[6]Research Associate, Dept. of Mechanical Engineering, Columbia University.

[7]Periodic Heat Flow—Homogeneous Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr. (ASHVE Journal Section, Heating, Piping & Air Conditioning, September 1944.)

author agreed that there should be some correction in sol-air temperature for radiant heat loss from a building at night.

Although heat transferred through the walls might be unimportant as mentioned by Dr. Carrier, its value could now be accurately determined and therefore it would be worthwhile to ascertain its effect in the opinion of the author.

Professor Mackey expressed appreciation of Dr. Carrier's reference to the sol-air concept as new. The authors also believed that it was the first attempt to combine air temperature and solar radiation. He pointed out the value of the sol-air temperature for laboratory use in which it could be used to simulate the effect of any desired cycle of temperature and sunshine on the walls of a test room having no exposure to sunlight.

President Downs announced that A. O. May, Chicago, Ill., would present a resolution from the Chapter Delegates Committee.

Mr. May presented the following resolution, passed by the Chapter Delegates Committee, for the purpose of improving the method of selecting Society nominees for office:

The Nominating Committee shall consist of eleven members of the Society qualified to vote, who shall have held membership in the Society for at least the five previous years. Seven members of the Committee and an alternate to be elected by the Chapter Delegates in attendance at the meeting of the Chapter Delegates Committee to be held the first day of the Annual Meeting. Four members of the Nominating Committee and an alternate to be elected by the Council at the previous Fall Council meeting.

It shall be provided that no member of the Nominating Committee shall be a member of Council, and that no two members of the Committee shall come from the same Chapter area, and at least one from each regional area to be established.

Round trip railroad fare and lower berth shall be paid to the members of the Nominating Committee in attendance at the Semi-Annual Meeting where the final selection of nominees shall be made.

C. F. Boester, Lafayette, Ind., stated that the reasons for submission of the resolution had not been given. He advocated the retention of the present method of making nominations because he felt that a larger number of members on the Nominating Committee provided a better representation than would a smaller number. He pointed to previous Society officers as examples of the effective functioning of the present system, and advocated the selection for office of men who had served the Society through presentation of papers and service on the Research and other committees.

F. W. Legler, Minneapolis, Minn., spoke in favor of the present method of selecting nominees because he felt that the Western Chapters now had adequate representation while a change might reduce it.

Dr. Carrier suggested that Mr. Jones present the viewpoint of past presidents. He advocated that nominees should be selected for the good of the Society regardless of regional interest.

Mr. Jones mentioned that consideration had been given to suggestions for changing the Nominating Committee almost every year during the past twenty. He recalled that while there had been occasional instances of politics and log rolling, the present method had worked quite well.

Mr. Jones cited instances in which the Nominating Committee members who selected nominees in June were alternates who were not familiar with previous consideration of candidates at the Annual Meeting. In the past, he said, the same men often represented chapters for many years in succession because they were the only ones going to the meeting from the chapter. They had served the Society well because of their keen interest in its affairs.

While Mr. Jones emphasized that he did not speak in favor of the motion, he felt that the number of Nominating Committee members which should be selected by the Chapter Delegates should be five rather than seven. If the present system serves the Society best, Mr. Jones preferred to keep it but if it should not do so then he advocated search for an improved system.

J. D. Slemmons, Columbus, Ohio, spoke in favor of the present method of making nominations and stated that the rapid growth and even the formation of the Central Ohio Chapter was due to the opportunity afforded the Chapter to participate in Society matters. He believed the present Nominating Committee procedure maintained a close contact of Chapters with Society affairs.

Mr. Blankin stated that favorable action on the resolution could only send it to the Constitution and By-Laws Committee, after which it would be presented to the Society for adoption when prepared in the proper form. He stated that Mr. May had not read the last part of the resolution which was as follows:

If this resolution meets with the approval of those in attendance at the 51st Annual Meeting of the Society in Boston, it is then recommended that the final draft of the resolution be referred to the Committee on Constitution and By-Laws for proper drafting, so that the change in the Constitution and By-Laws can be submitted for vote of the Society in the regular way at the next Semi-Annual or Annual Meeting of the Society.

Mr. Blankin gave as reasons for the resolution: (*a*) the difficulty of having the same representatives at the January and June meetings, (*b*) the difficulty of obtaining a quorum at the meetings, (*c*) the increasing expense to the Society of a large committee which might amount to $3000 per year, (*d*) the lack of representation of approximately 30 per cent of the members who were not Chapter members.

Mr. Jehle inquired whether the proposed resolution stipulated that the seven members were to be selected by delegates in attendance at a national Society meeting and also asked whether the proposed plan would reduce Society expense.

Mr. May read the resolution again and explained that the Chapter Delegates would select from their number a representative for several chapters which would constitute a zone.

Mr. Blankin explained that the Chapter Delegates Committee was in existence as a Constitutional Committee and that its expenses were authorized.

President Downs added the comment that the expenses of Chapter Delegates were authorized by the Council only. He also pointed out that the authority for the Nominating Committee was the By-Laws and not the Society Constitution.

It was moved by Mr. Jones and seconded by Mr. Blankin:

> THAT the resolution be referred to the Council for transmission to the Constitution and By-Laws Committee with instructions to present the resolution in proper form for Society action at a later meeting.

Mr. Avery reminded the members present that by previous action at the Annual Meeting in Cincinnati the Society had voted against a Constitutional Amendment which would reduce the Nominating Committee from 31 to 6 members. He advocated that the motion be voted down unless the members intended to vote for the resolution when the Constitution and By-Laws Committee would present it for Society action.

The motion was approved by a 52 to 38 vote.

President Downs called for the Report of the Tellers of Election for Officers and Committee on Research and C. S. Koehler, New York, N. Y., presented the report (published in the February 1945 Journal Section, p. 107).

The meeting adjourned at 5:45 p. m.

Second Session—Tuesday, January 23, 9:30 a. m.

The second session convened at 9:30 a. m. with Vice-Pres. C.-E. A. Winslow, New Haven, presiding.

Chairman Winslow called for the Report of the Committee on Research (complete report to be published).

which was presented by Prof. G. L. Tuve, Cleveland, Ohio, chairman.

Chairman Winslow expressed his appreciation of the excellent work done by Chairman Tuve and Cyril Tasker, Director of Research, in organizing the research program and establishing the new Research Laboratory in effective operation.

The following message from R. M. Conner, Director, *AGA* Testing Laboratories, Cleveland, Ohio, was read:

Will you please express for me, following presentation of your report tomorrow, the *American Gas Association's* thanks for the help given us especially by your Laboratory following recent disaster to our laboratories. As you know we intend to contribute to your 1945 research fund. Our Association also sends greetings and best wishes for the Society's Annual Meeting.

The Chairman then presented W. E. Crowell, Buffalo, N. Y., who presented an abstract of his paper, Altitude Chamber for Study of Heating and Air Conditioning Problems (published in October 1944 Journal Section, *Heating, Piping & Air Conditioning*).

H. B. Nottage, East Hartford, Conn. (Written): The most valuable feature of this paper is the challenge which is offered to one's imagination in considering the sort of quantitative data and methods which would be involved in establishing solutions to the important aircraft problems mentioned.

The author has emphasized well the vital importance of *weight* as an aircraft design factor. In the usual designs for residences and buildings, weight enters only indirectly as the cost of space occupied and represented by so much material. But the foundations and structure of buildings are designed according to principles which *in no way approach* the *extremely critical balance* of the many component elements of an airplane which must fly through the skies as a single, closely-knit unit. For instance, it has been estimated[5] that each pound added to an accessory of a pursuit-class aircraft will result in an overall increase of 5 lb to the entire take-off weight of the airplane! The airplane must be designed as a *matched* assembly of many parts to meet an exacting specified performance.

Many Society members are interested in combustion and perhaps feel that they are identified with highly effective types of combustion equipment. But the problems of maintaining efficient combustion in aircraft heaters with high-altitude air have only served to emphasize the unsolved problems which abound in the combustion field. It seems appropriate in this connection to ask if the group at Curtiss-Wright Research has accomplished anything in this particular regard.

Then, too, the physiological problems of maintaining human comfort in flight are much more critical than for ground structures. If a person feels uncomfortable while in a building, no vital danger is ordinarily represented to him thereby. But, in the case of military personnel or crew members, discomfort may be a prelude to acute difficulties which might seriously endanger either the individual or the entire aircraft. Quick action in the response of a person to an emergency will be hampered by a lack of oxygen or by serious overcooling of portions of his body. Also, commercial travelers pay for *comfort*. The author has mentioned the importance of *radiation* in the comfort heat balance, and he has indicated the further difficulties of corrective equalization of air temperature with rarified air under cabin conditions.

These problems, and others of equipment design, installation, and operation would seem to belong in the progressively expanding domain of heating, ventilating, and air conditioning. All of the many problems which come up for altitude-chamber study must ultimately yield to expression in terms of engineering experience and physical law. It is to be hoped that the Society will continue to actively contribute its proper share in this field, for there is much to be done.

W. E. Zieber, York, Pa. (Written): The author is to be commended for the apt manner in which he has shown the many problems facing us from the aviation standpoint in the war effort.

My associates have been faced with a few of these problems since they have furnished much apparatus of types similar to that described. They could not know the extent of the problems that the author would be compelled to solve, in his position.

Because of the time element involved in the war effort, designers are forced to use their past knowledge and experience to make such apparatus operate as well as possible today. Time and continued effort will reveal knowledge for improvement.

Referring to this apparatus—to accomplish the speed of reduction of temperature required in the lower shell, refrigeration is stored in the mass of the upper shell before attempting to cool the lower one. Insulation is put on the inside of the shells to prevent trouble with the shell material. No insulation adhesive is used because none could be found that would hold at low pressures.

More could be said about such problems which show that those who build such apparatus have many things to learn. It is possible that the methods of producing low temperatures can be improved in the future.

I am sure that we, as engineers, will accept the responsibilities shown us by the author. We will need to cooperate in every possible way to accomplish the requirements of the war.

The necessities after the war are going to demand much attention. To be able to take care of the comfort and safety of human beings and maintain the proper performance of equipment and instruments will require the closest cooperation between the air conditioning engineers and the engineers of the aircraft manufacturers and operators. This cooperation will be necessary in the research phases as well as those of application. It will be necessary in times of peace to obtain knowledge for use when and if there are any future wars.

Prof. M. K. Fahnestock, Urbana, Ill., spoke about the importance of aircraft air conditioning and said that post war commercial aviation would be entirely different from commercial aviation. In commercial aviation 1 lb of heater weight reduction is worth from $100 to $150 in a DC plane.

While performance rather than comfort is the chief concern in military aviation, comfort is essential in air transportation in civilian aviation.

Many other items which are of importance in military aviation such as: rate of climb, high altitude, and hazards of explosive decompression are not of importance in civilian aviation, but other factors such as odors, which are of concern in evacuation hospital planes, are important. Economic considerations are important in civilian aviation but may be disregarded in military planes.

E. A. Norman, Jr., Columbus, Ohio, spoke of the possibility established by recent developments of burning liquid fuel at a rate of 5 to 6 million Btu per (hr) (cu ft) of combustion space and believed that the near future might establish the possibility of increasing the rate to 10 million Btu.

L. T. Avery spoke about the important inter-relationship of air conditioning, refrigeration, and physiological reaction and stated that it suggested a Society responsibility.

Dr. Winslow referred to the importance of the humidity problem at high altitudes. Its effect upon human beings could be evaluated from tests conducted and reported by L. E. Seeley, New Haven, Conn., and also at the John B. Pierce Laboratory of Hygiene. The quantitative effect could be computed from the quantity of air breathed on the assumption that it would be changed to 90 per cent saturation at 95 F when exhaled.

Author's Closure: In closing the discussion, Mr. Crowell pointed out that the present high plane speeds, by causing an air temperature rise due to kinetic energy given up to the surface, created a cooling problem.

Chairman Winslow suggested that Mr. Crowell's remarks might lead to a cooperative research project be-

[5]The Intercooling Problem in Airplane Design, by H. B. Dickinson. (SAE Journal, Vol. 52, p. 557, 1944, December.)

tween ASHVE Committee on Research and the aircraft industry and that in such a project the Society would be delighted to be of service.

Chairman Winslow then called for the paper, Thermodynamic Properties of Moist Air, which was presented in abstract by John A. Goff, Philadelphia, Pa. (complete paper and discussion to be published in later issue).

Chairman Winslow joined the other commentators in paying tribute to Dean Goff's contribution to the Society. He also stated that no other society had contributed so much as had ASHVE to the science with which it deals.

The final paper, Air Cooling Coil Problems and Their Solutions, by L. G. Seigel, Cleveland, Ohio, was presented in abstract by the author (published in February 1945 Journal Section, *Heating, Piping & Air Conditioning*).

Mr. Nottage suggested that pressure drop problems should be given consideration in referring to coil performance. It would also be helpful to define performance. Other questions suggested were: Is a test for particular desired condition or construction always necessary? How is the test method related to design problems?

Mr. Nottage suggested that emphasis should be given to the fundamental basis for the statement that coil performance "involves only sensible heat coefficients irrespective of simultaneous mass transfer and variations of wetted or frosted surfaces." From Table 1 it appeared that coil surface temperature is a single and precisely defined variable. It would be expected, however, that surface temperatures would vary considerably from point to point.

In future work, Mr. Nottage said that it would be helpful if the data were given fundamental interpretation in terms of the proper heat-transfer conductances, air-side, metal and refrigerant-side, and compared in basic terms to available information in current literature.

It was suggested that the erratic variation of the refrigerant side coefficient might be due partially to the method of analysis, from Equation 3 of Table 1, which was used. Further information on the limitations in number of coil rows for which performance could be predicted would be desirable.

The question was also asked whether the method of analysis given in the paper also applied to flat plate and bare tube surfaces.

Mr. Nottage also inquired whether there were limitations in the range of air temperature pressure or moisture content which would affect the accuracy of the humidity method.

C. M. Ashley, Syracuse, N. Y., remarked that the *film coefficients* as used in the paper were not true physical film coefficients, particularly on the refrigerant side. All three equations involved approximations which were slight in the first two, but were of considerable importance in the third equation (in which three approximations were used) and might account for the low accuracy of the refrigerant-side coefficient.

On the whole the method appeared to be one of the best given to date and should serve as a starting point for additional work. The limited range of temperature and coil depth used might account for the apparent accuracy of the method, and since other methods had been devised to work well within a limited range, it might be advisable to extend the range in depth of coil, water temperature, and surface temperature to determine whether the same accuracy would still be maintained. If the accuracy would be maintained under wider range of conditions, then the method would be established on a more firm basis.

Mr. Ashley emphasized the importance of determining actual film coefficients in order that comparisons of results could be made with results obtained from various other sources.

W. C. Whittlesey, Washington, D. C., stated that the research work on which the paper was based had a considerable influence on naval design. The method presented in the paper had been developed as a simplified procedure for the use of individuals with limited technical experience and many refinements suggested by the previous commentators, he said, had been considered and discarded as of little practical value in selecting coils for naval vessels.

Standardization was desirable to facilitate replacement of coils. It had been possible to select from a series of 6 coils a proper application for any refrigeration tonnage up to 20 tons and for any heat ratio from 4/10 to unity.

Professor Tuve expressed his appreciation of the support of the Navy Department Bureau of Ships and the Society given to Case School of Applied Science in the project covered by Mr. Seigel's paper. He suggested also that those who do not have an opportunity to comment on technical papers presented to the Society should send written discussions to the various authors, in order to aid the Society and Technical Advisory Committees in work on various projects.

Author's Closure: Mr. Seigel stated that although Equation 3 was approximate, it was difficult to correct it without having more exact data on film coefficients. The determination of mean temperature from row to row of coil was still an unsolved problem.

The humidity method had been used for coils of 2 to 10 rows and had been satisfactory. Beyond 7 rows of tubes most coils reached the saturation curve.

The author thought a similar method could be applied to cooling towers, but stated that he had found difficulty in determining actual surface areas in cooling towers and felt that this difficulty was an obstacle in attempting to apply the method.

The session was adjourned at 12:30 p. m.

Third Session—Tuesday, January 23, 2:15 p. m.

The third technical session convened at 2:15 p. m., January 23, 1945, with Vice-Pres. A. J. Offner, New York, N. Y., presiding.

Mr. Offner presented J. F. Collins, Jr., Pittsburgh, Pa., Chairman of the Guide Publication Committee, who gave a report for the committee on The 1945 Guide.

Report of Guide Publication Committee

During the past busy war year, 50 authors have contributed much time and thought to writing, revising and improving the 23rd Edition of THE GUIDE and many other members have offered valuable suggestions to the Committee on its work. To determine policy, the Committee held several meetings during the year, and the individual members of the Committee each have acted in the capacity of sponsors for the changes being made in groups of chapters.

I will not take your time now to tell you of the work that has been done on the individual chapters. Such a list will be found in the preface to the book. However, I draw your attention to the new chapter on the important and popular subject of Panel Heating and Radiant Heating written in part by our President-Elect, Dr. Winslow, and in part by our Past President, Dr. F. E. Giesecke. This chapter has been examined by a number of members who are engaged in this field and has been pronounced as very excellent and one which will bring much credit to the Society.

You will find that while the page size has not been altered, each page in the text section of the new GUIDE has three more lines than in former editions. By this change, therefore, the total amount of technical text was actually increased.

It is suggested that the next Guide Publication Committee attempt to prepare chapters in as nearly a final form as possible in order to relieve the Technical Secretary of the tremendous load which develops at the end of the year if chapters are delayed and if they need much editorial revision to prepare them for the printer.

The Guide is an important activity of the Society from a financial as well as a technical viewpoint.

Respectfully submitted,

J. F. COLLINS, JR., *Chairman*
Guide Publication Committee

Mr. Dill presented an abstract of his paper, A Survey of Testing Methods and Rating Limits for Domestic Heating Devices (published in January 1945 Journal Section, *Heating, Piping & Air Conditioning*).

J. E. Axeman, Williamsport, Pa. (Written): The author has made a very able summary of the testing methods and rating limits for domestic heating devices and this paper should provide a ready reference for those interested in these codes.

It is evident from the author's summary that considerable progress in establishing codes has been made in recent years and this work has certainly been a great contribution to the domestic heating equipment field where various and sometimes questionable ratings were prevalent.

The extension of these codes to other equipment should be encouraged as they afford a necessary protection to all parties concerned in the purchase of equipment. This protection is particularly desirable in the domestic heating field where, unfortunately, purchase and installation of the equipment is at times made without the services of a specifying engineer or competent heating contractor; and even when the purchase is made by competent parties there should be some recognized standard to determine true output of equipment.

While it is not the purpose of the author's paper to discuss the technical aspects of these codes, it is significant to note that relatively low efficiencies appear to be acceptable. It is to be hoped, however, that this will be an inspiration to the industry to develop equipment showing higher efficiencies rather than equipment designed just to meet the minimum efficiencies acceptable under these codes.

M. W. McRae, Chicago, Ill. (Written): The author was modest in his statement that, "A summary such as this may serve a useful purpose in affording an over-all view of testing methods and rating limits, . . ." Unquestionably, this compilation will be very useful to those of us engaged in the testing and rating of domestic heating equipment and also to others in related fields.

As the author points out, it is obvious that a survey of this type should not be construed as criticism of any one test method; neither should it be interpreted as a comparison of one type of fuel or equipment with another. However, the tabulation in Fig. 1 brings out quite forcefully the wide variation in rating limits for heating devices having the same general purpose and fired with the same type of fuel. For example, the minimum efficiency permitted for coal-burning space heaters and warm air furnaces is 50 or 55 per cent, depending on whether the unit is magazine fed or surface fired, whereas, for steam and hot water boilers the minimum is 58 per cent. At first glance, this difference does not seem to be significant, but when it is remembered that the efficiency curve is relatively flat, it becomes evident that a variation of 3 per cent in efficiency may change the allowable rating as much as 20 per cent.

Similarly, the maximum allowable stack temperature is much higher for the oil-fired, warm air furnaces than for steam and water boilers using the same fuel. The maximum stack temperature permitted for these warm air units varies from 780 to 920 F plus room temperature. This latter figure means an actual stack temperature of approximately 1000 F, and, at a minimum efficiency of 70 per cent as specified in Commercial Standard 101-43, and disregarding all other losses, the CO_2 for these heaters would need to be at least 12½ per cent as indicated by the combustion curves shown in a circular[8] published by the University of Illinois. In comparison, the maximum stack temperature permitted for steam and hot water boilers, when oil-fired, is 600 deg including the room temperature. This is quite closely in accord with the 480 and 530 deg plus room temperature permitted by the *American Gas Association* for central heating appliances.

In summarizing these comments, there are three points that should be emphasized as follows:

1. An extremely wide range of maximum allowable stack temperature is permitted by the various testing and rating methods currently in use.
2. The limitations imposed on their own equipment by manufacturers' groups, such as the *Institute of Boiler and Radiator Manufacturers* and the *American Gas Association*, appear to be much more conservative than similar requirements listed in Commercial Standards.
3. To insure equivalent performance of domestic heating devices utilizing the same fuel, it would seem desirable to establish these limits on a more uniform basis.

I would like to repeat that this survey is of great importance and we are indebted to the author for tabulating the available information so that these discrepancies are so obvious.

R. K. Thulman, Washington, D. C. (Written): The author has prepared a very able and simple recapitulation of the testing and rating limits for domestic heating apparatus. A summary of this kind, in addition to affording an over-all picture of the domestic heating field, serves two additional useful purposes. *First*, it emphasizes the need for coordination of the existing Codes and Standards. *Second*, it points out the need for Codes and Standards for apparatus presently not covered.

The survey covers apparatus used principally in residences and mostly in small residences. In the field of small home construction the buyer is less protected by adequate specifications and architectural and engineering advice than is the case in the more costly field and in the commercial field. The home buyer rightfully expects that the heating system in the house which he purchases will be safe, efficient, economical and convenient of operation and will provide heat throughout the dwelling in an acceptably uniform manner.

The service of the heating industry ultimately expresses itself to the consumer in these terms. The Codes and Standards covered by the survey are tangible expressions and a voluntary attempt to meet a recognized obligation by the industry to the public. These Codes and Standards are a recognition of a responsibility which goes farther than that which attaches to the manufacture and sale of any one of the several devices which may collectively supply the heating service. In other words the formulation of these separate Codes without reference one to the other threatens to perpetuate a division or even a lack of responsibility which has characterized the industry in the past. Several devices may be actually needed to constitute a complete heating system. The need for coordination appears clearly in any such case and suggests the necessity for certain collective or comprehensive Standards that will blend the separate individual Codes into an effective and proper whole.

Both the coordination of existing Codes for this purpose and the initiative in the preparation of Codes to fill in the gaps should, in my opinion, be an obligation of the ASHVE. The Society alone seems to be the logical agency to coordinate the wants and needs of the industry with the wants and needs of home owners and yet for some reason completely unclear to me, the Society has avoided this particular opportunity for public service.

Both the Society and the industry face a task of public education, it is true, but the public has for some time been trying somewhat inarticulately to educate the industry. The heating industry complains that the percentage of over-all cost budgeted for heating is too small to enable it to furnish the full comfort which it is capable of providing. One of the chief causes of complaint from the home owner on the other hand is the failure of his heating system to perform as he had been led to believe it should.

The situation seems to be one of simple cause and effect and I recognize that it can be argued which is the cause and which is the effect.

[8] Combustion Efficiencies as Related to Performance of Domestic Heating Plants, by Kratz, Konzo and Thompson. (Circular Series No. 44, University of Illinois Engineering Experiment Station, p. 10.)

The over-all view which the author's paper affords suggests that this situation could largely be overcome and that final results beneficial both to the public and heating industry would result if this Society acts as the coordinating agency to reconcile the inconsistencies in existing Codes and Standards, to initiate the preparation of Codes and Standards now lacking and to combine the results in a residential heating Standard.

R. C. Cross, Chicago, Ill., defined a code as a body of classified laws and a standard as an established rule. He stated that a code for testing devices for functional performance should be consistent with actual conditions of usage and be practical so that it could be utilized by the average testing laboratory.

A standard, said Mr. Cross, should provide a direct means of comparison for selection of merchandise and should incorporate levels of quality equal to or better than the average known to exist in order to permit higher levels of measurement with normal progress taken into account. Mr. Cross felt that the quantitative limits established by some of the standards were mediocre and were based upon the desire to obtain the sanction of given interested groups rather than upon desired engineering progress.

Ferdinand Jehle stated that the various standards were concerned with firing devices only and therefore should be extended to controls, thermostats, air valves, traps, pumps, etc., which often determined whether the heating plant would operate satisfactorily.

L. E. Seeley, New Haven, Conn., inquired about the number of codes that had materialized within the last 5 or 10 years and surmised that the preparation and acceptance of codes was becoming accelerated.

Author's Closure: In reply to Professor Seeley, Mr. Dill stated that the Trade Standards probably were less than five years old except the one pertaining to stokers and that the I-B-R codes were less than five years old.

Chairman Offner thanked the author and the commentators. He announced that the registration at the meeting at 2:20 p. m. was 555.

R. J. Lorenzi presented an abstract of the paper, The Influence of Heat Capacity of Walls on Interior Thermal Conditions and Heat Economy, by C.-E. A. Winslow, L. P. Herrington, and himself, New Haven, Conn. (complete paper to be published).

R. A. Miller, Pittsburgh, Pa., inquired how night cooling was simulated in the tests reported on the paper.

Dr. Winslow replied that in the tests there was no sun effect during the day nor radiation to interstellar spaces at night. The tests showed the effect of cycles of outdoor air temperature variation from 65 F to 95 F.

It was interesting to find that the heat capacity of the walls provided a considerable protection in regard to internal temperature variation.

The final paper for the session was Radiation Corrections for Basic Constants Used in the Design of All Types of Heating Systems, by B. F. Raber and F. W. Hutchinson, Berkeley, Calif., and was presented in abstract by Professor Hutchinson (published in December 1944 Journal Section, *Heating, Piping & Air Conditioning*).

H. F. Randolph, Utica, N. Y. (Written): The paper on radiation corrections is a rational method of designing a heating system for a comfort condition rather than, as so generally is done, for a fixed temperature.

The rather laborious method of arriving at the same results in the past has deprived small structures of the benefit of proper allowance in the heat load calculation, other than from some arbitrary addition.

This simplified method I hope will find its way into THE GUIDE and I also hope that for a more accurate application a table will accompany the graph, especially for the range of overall coefficients of heat transfer and outdoor temperatures most commonly found. I believe this paper is a splendid contribution.

W. E. Crowell, Buffalo, N. Y., reported that in calculating the air temperature required for comfort in the cabin of an airplane which had a large canopy area, through which the solar radiation entering was high, he had obtained a value of 30 F. The wall temperature of the cabin was taken as 156 F. He requested the author's comment on the possible error of such a low temperature.

H. B. Nottage, East Hartford, Conn. (Written): Being privileged to speak from an interest in the physical principles dealt with in this paper, rather than from actual panel heating design experience, the subject material presents a strong appeal on the basis of the philosophy of judging design problems which it represents.

It seems that the authors deserve commendation for their having pointed out the limitations which need to be considered in the too-broad application of the standard average film coefficients. The future is bound to see the development of unconventional designs which will require occasional modifications from current standard procedures, and it is well to keep constantly in mind the *principles* upon which such modifications will be based, in accord with the discussions of this paper.

The authors have advocated that designs which depart from established experiences in the relative balance of radiant and corrective heat transfer should be analyzed in terms of the *fundamental principles* which govern *each* of these *component processes*. Their division of the over-all problem into its components, and the analysis of these components separately, should be an important contribution to the background of design literature being established by the Society. Generally speaking, heating design should be a true analytical procedure which has reference to both an average standard system or method and rational departures therefrom.

Authors' Closure: Professor Hutchinson stated that the present paper was the result of studies made following a discussion of a paper,[10] which was submitted at the 1943 Semi-Annual Meeting of the Society.

While the authors had made certain studies in connection with aircraft design they were not at liberty to discuss them at the present time. Professor Hutchinson referred to papers by Prof. B. F. Raber and himself in the *Institute of Aeronautical Science Transactions* in July, 1944, in *Aviation Engineering* magazine in December, 1944, and in *Electrical Engineering* magazine in January, 1945, as additional sources of information.

It was pointed out by the author that the paper presented referred to the equivalent over-all coefficient of heat transfer, *U*, and not to the equivalent conductance.

The curve presented in the paper was not intended for use for panel heating systems, but applied to non-radiant heating systems. The curve, however, would apply equally well in either summer or winter.

Chairman Offner thanked the authors and commentators. The meeting was adjourned at 3:30 p. m.

Fourth Session—Wednesday, January 24, 9:45 a. m.

The last session convened at 9:45 a. m. with Pres. S. H. Downs presiding.

President Downs introduced W. N. Witheridge, Detroit, Mich., who presented an abstract of his paper, Control of Industrial Atmospheres (published in December 1944 Journal Section, *Heating, Piping & Air Conditioning*).

L. T. Avery, Cleveland, Ohio. (Written): We are indebted to Mr. Witheridge for daring to criticize, if ever so gently, the heating and ventilating technique that has been so common in the industrial plant. Handling air is not easy, and to do a good job of industrial air conditioning requires topflight engineering, and plenty of money. Too many gadgets have been sold as a temporary palliative to the plant manager who grabs at a low cost, quickly secured fan, which visibly and audibly

[10] Performance of a Residential Panel Heating System, by H. F. Randolph and J. B. Wallace (ASHVE Transactions, Vol. 49, 1943, p. 235).

handles a *lot of air* but which quiets the complaint only while the item is on order. When finally the installation is completed, the season has changed, or maybe the complainant was fired or promoted and another year rolls around with nothing really accomplished.

The author touches the whole field of industrial ventilation, but I wish to comment on one in particular that is right now at the top of the list, and that is foundries. Grey iron castings are a bottleneck in the war program and new emphasis is being put on *cleaning up the foundry*. Apparently foundries have been neglected by the heating engineer because there was so much wild heat that it was considered *carrying coals to Newcastle* to install a decent heating system. There was so much smoke that no one really dared try to collect it, and silicosis, pneumonia, and tuberculosis were considered as a functional weakness of the particular type of worker rather than direct results of the quality of the air. When you can't hire enough workers to keep your plant busy you begin to wonder why. If the absence rate is 500 per cent greater in your foundry than in the adjacent machine shop you ask questions. If the industrial commission sets up a merit rating for your foundry and you get charged with your own silicosis cases, then maybe you decide it is not an expense, but a good investment to provide a good working environment, airwise.

The Ohio Industrial Commission states in its December, 1944, bulletin, "Silicosis originating in foundries continues to be one of the major problems confronting the Industrial Commission of Ohio". A recommended schedule of sanitation is established, including among other things a suggestion of 15 changes of air per hour in a mechanical foundry. That's a lot of air! And in zero weather that represents a lot of heat. And unless you clean it that includes a lot of dirt to throw over the fence at the neighbors. One of our industrial plants was recently given permission and priority to remodel its office into a windowless air-conditioned enclosure because the neighboring foundry spewed forth such quantities of dirt and smoke that open window ventilation was *detrimental to the health of the workers*. Mind you, the health of the workers! Nothing was done about the health of the foundry employees working continuously *inside the foundry*.

Major James Roeder Bell, Cleveland, now medical officer in the Air Corps, used to say that the phrase *air conditioning for comfort* was a misnomer. He said the body of comfort was the healthy body and all a doctor could do was to relieve the symptoms of discomfort, whereupon the patient became well. Air conditioning has come to be identified with summer cooling, and summer cooling is considered for comfort only, and therefore on the shelf for the duration. But in the broader, and more accurate sense, air conditioning in the foundry must be the correct term to use. How else do you cover the entire problem of collecting the dirt at the shakeouts and knockouts, removing it from the air and discharging it at a quality and location that doesn't menace your neighbors or contaminate your own adjacent building? You have the smoke and oil vapors and gases to remove, without drawing them through the worker's breathing zone. What of the heat, the terrific, incessant, penetrating heat that opens up the capillaries, overstrains the heart, and dehydrates the worker? After you plan the exhaust systems and equipment you must provide equivalent supply air, and this must be good air, not recirculated smoke and dirt. In the winter the supply air must be heated and distributed to promote the health of the worker. In summer that air must be as cool as possible, not taken off a hot roof, and it must be distributed to flow through the workers to the heat of castings and cupolas, instead of vice-versa. Pedestal recirculating fans are a menace and create more problems than they solve, often blowing smoke and heat away from the worker directly onto another. He who *hollers* loudest wins. The successful heating and ventilating of the foundry, the *cleaning up of the foundry* if you like, is the highest type of air conditioning and unless the problem is reflected it will not be solved.

Many of you recall the old argument championed by Dr. E. Vernon Hill about outside air *vs.* fresh air. He said there was no such thing as fresh air! That's particularly true around a foundry. So the next step will be to cleanse and purify the supply air, which can be done easily with present-day equipment, so that recirculated air will be purer—or fresher—than outside air. Then the excessive heating loads will be brought within reason, and the foundry that now uses a 2500 hp boiler for heating 1,750,000 cfm will be heated by a 200 to 300 hp boiler when the foundry is running light and the wild heat will do all the heating when the production is under full blast. Codes now prohibit the recirculation of exhaust air back to the foundry, even though cleaned, but the fellows who wrote those codes did not know what clean air was. Certainly nothing is said about where the new air comes from and in many cases it actually does short-circuit from the exhaust. What a glorious field is opened to the air conditioning engineer, who really can cooperate with the industrial hygienist, with management, with safety and personnel departments, and with the industrial commissions and insurance companies to provide a healthy and comfortable working atmosphere, *even in the foundry!*

A. D. Brandt, Chicago, Ill. (Written): My first reaction to this paper was merely to say *good work—I heartily endorse it*. However, since emphasis is gained by repetition, it may be well to add further emphasis to several of the issues which in my opinion are very important.

My experience in a variety of plants, both large and small, scattered throughout the country checks that of the author's as regards the much-too-large percentage of ventilating systems for industrial atmospheric sanitation which are wholly inadequate, very much over-designed, or interfere with operations to an excessive extent. This is *not* a condemnation of the industrial engineering personnel at these plants. These engineers are busy men—they have a thousand and one things to do, of which the design of a ventilating system to control dust, fumes, or gases is probably in their estimation very minor and something of a nuisance. Atmospheric sanitation is such a small part of their work that they cannot be specialists in the field.

Furthermore, while proper ventilation is the most important single method of accomplishing industrial atmospheric sanitation, in most instances the proper control of a hazard comprises the use of a combination of control measures including proper ventilation, but not ventilation alone. An adequate, efficient, and inexpensive design job can be done only by someone who (1) appreciates the full significance of the hazard, (2) has a good knowledge of the physical characteristics of atmospheric contaminants, (3) has had experience in atmospheric sanitation and recognizes the relative value of the several measures of dust, fume, and gas control, (4) has sufficient knowledge of industrial toxicology to decide which control measures are best fitted for the operation under consideration, (5) has a working knowledge of the fundamentals of air flow into various types of suction openings, and (6) can design a balanced exhaust ventilation system. This certainly does not look like a good summary of the qualifications of a ventilating engineer, and should serve to demonstrate that industrial atmospheric sanitation or industrial hygiene engineering is a specialized field. It is a field for which sanitary or chemical engineers with special training in industrial toxicology and ventilating engineering, or ventilating engineers with special training in chemistry and industrial toxicology are best fitted.

Thus it should be apparent that industrial hygiene engineering is not an *off-spring* of ventilating engineering, even though proper ventilation is the most important tool of the industrial hygiene engineer. The ventilation employed by the industrial hygiene engineer is, by and large, a special type of ventilation and in many instances if the system is designed properly produces little ventilation as defined by the ASHVE. In fact, the more efficient the system the less ventilation is actually produced. Local exhaust ventilating systems in most instances are poor excuses for ventilating systems in the true meaning of the word—they are pneumatic collecting and conveying systems designed to capture and transport as much dust, fume, or gas as possible with as little air as possible. Frequently they do not even figure importantly in the heating and ven-

tilation of buildings. Nevertheless, most of the fundamental principles involved are those of ventilating engineering and consequently industrial hygiene engineering should, and eventually must, be of a direct interest to the ASHVE. It seems to me that this co-relationship, this interdependability, between ventilating engineers and industrial hygiene engineers cannot be ignored much longer. The time has come, I am confident, when it is imperative that the ASHVE establish a committee which will cover all phases of industrial hygiene engineering, not only one or two phases such as *Air Cleaning* and *Air Conditioning in Industry*.

W. L. Bryan, Jr., Long Island City, N. Y. (Written): This paper given by Mr. Witheridge is most timely. The increased stress of war production has broadened the field of Industrial Hygiene and brought its advancements and needs into focus. In that section of Industrial Hygiene which deals with environmental control, this paper gives a most enlightening and thought provoking analysis.

Those of you who have participated to any degree in this field, I am sure, will go along with me in corroborating the experienced information presented by the author. I think that Mr. Witheridge hit a very important "nail on the head" when he stated the need for the *ventilation rates required* to control the hazard of a given industrial process.

In the Industrial Hygiene field we have a large amount of information in the maximum allowable concentrations. On the other hand, in the field of ventilation we have a large amount of information on producing ventilation at a particular rate and quantity over an area. What we need now is to combine these two factors. Government agencies in writing codes have attempted in certain cases to do this. The results are none too satisfactory.

It has been my feeling that the amount of ventilation required to reduce a given contamination below a certain allowable concentration is a problem for the ventilating engineer. As such it is of immediate concern to the ASHVE.

P. W. Gumaer, New York. (Written): We are fortunate in having such an excellent paper on industrial ventilation presented by one with such long and varied experience.

Mr. Witheridge has done an excellent job in the preparation of the list, *Common Causes of Failure*. His remarks on maximum allowable concentrations, however, favor an oversimplification which is not warranted if maximum efficiency and economy are to be attained.

In 1930 I made the following statement at the 19th Annual Safety Congress:

"The ventilating engineer talks in terms of temperature, humidity, velocity of air, or quantity of air removed. These are his standards of ventilation. They are sufficient in dealing with problems of ordinary ventilation such as theaters, schools, hotels, etc. These standards of ventilation are of little value in obtaining effective ventilation of solvent vapors, especially when they are heavier than air. The proper standard of ventilation of industrial vapors is the amount of the vapor remaining in the air that the workmen breathe. That is what we need to measure. The other standards may be useful in obtaining the desired result. Unless we have a means of measuring the amount of vapor breathed by the workmen, we are never sure of the effectiveness of ventilation equipment."

Industrial hygienists today appreciate the necessity of determining the concentrations of toxic materials in workroom air. The ventilating engineer, if he is not to be outdone by his competitor, must understand maximum allowable concentrations. He need not be qualified to make actual determinations but he should understand the accuracy and limitations of the methods in general use.

I believe that the air conditioning engineer who is unfamiliar with Chapter 2—Physiological Principles, in the Heating, Ventilating and Air Conditioning Guide and who goes into his fan table with a comfort zone figure would also come out with a headache.

In this connection may I suggest that statements on maximum allowable concentrations in the 1944 Guide be revised. No reference is made to the official figures adopted by the *American Standards Association*. A definition of maximum allowable concentration and an explanation of its use should be given.

Philip Drinker, Boston, Mass., expressed approval of Mr. Witheridge's comments and advocated that Society members should take an active interest in industrial ventilation. In his experience he had found that installations for industrial ventilation frequently were made by firms not connected with air conditioning, although such work was directly within the field in which the Society members had special interest and ability.

C. H. Pesterfield, East Lansing, Mich., expressed the belief that Mr. Witheridge had succeeded in pointing out many shortcomings in the field of exhaust ventilation and in general ventilation for control of atmospheric contaminants. He referred to the difficulty of obtaining authoritative data from the medical profession on the rate at which the human body can accept harmful constituents in air, but thought that doctors were usually more conservative than many designers of equipment for control of the contaminants.

Professor Pesterfield cited the variation found in accepted amounts of ventilation required to control atmospheric contaminants. The paper by Mr. Witheridge, he believed, presented a direct challenge to the Society to establish acceptable standards for air velocities, duct sizes, air quantities, hood design characteristics and capture velocities which could be used by all engineers. Society action in bringing together various groups and societies interested in industrial ventilation was desirable and would result in an outstanding service to the public and the engineering profession.

H. M. Nobis, East Cleveland, Ohio, stated that too often production departments purchased and installed equipment causing atmospheric contamination without consulting an air conditioning engineer. He advocated that the engineer who is to design a system to produce acceptable conditions in an industrial installation should attempt to obtain his personal reaction to the conditions obtained in order to make certain that they are satisfactory.

C. S. Leopold, Philadelphia, Pa., in commenting upon the remarks of Mr. Gumaer invited him and all others interested to submit data on permissible quantities of atmospheric contaminants and stated that such data in authoritative form were not easy to find.

J. M. Kane, Louisville, Ky., mentioned that at least six States had been doing excellent work in establishing standards for industrial exhaust ventilation and that undoubtedly the others would institute an increasing number of regulations within the next few years. He believed that a central coordinating or controlling body having an engineering background would be an effective means of eliminating conflicting standards in various States.

C.-E. A. Winslow, New Haven, Conn., stated that the subject provided a great field for the ventilating engineer. He mentioned the difficulties which tend to arise from changes made in manufacturing processes after an exhaust system has been installed.

It was very important, said Dr. Winslow, that engineers and public health authorities cooperate in establishing standards because the specific rules and standards are usually promulgated by the public health authorities. He stated that reasonable uniformity in standards would be obtained mainly from the *American Public Health Association* and the U. S. Public Health Service because health authorities usually did not even know of the existence of the *American Standards Association*.

In Dr. Winslow's opinion it would be desirable to concentrate Society attention on the subject through increased activity of the Technical Advisory Committees on Air Cleaning and Air Conditioning in Industry. It was a vital subject and offered great future opportunities for the engineer.

Prof. L. G. Miller, East Lansing, Mich., expressed the hope that members would urge the President and Council to obtain through the Technical Advisory Committees and others interested all available data on the subject in order to provide an authoritative chapter on the subject in THE GUIDE.

It was Professor Miller's opinion that much of the absenteeism, which was equal to about 9 per cent in Michigan manufacturing plants, was due to unhealthful working conditions.

President Downs stated that he had made notes that the various committees which would be concerned in industrial ventilation standards would be Guide Publication Committee, Standards Committee, Committee on Research, Special Committee of the Council for Cooperation with Other Organizations, Meetings Committee, and Publication Committee.

W. L. Fleisher, New York, stated that the Technical Advisory Committee on Air Conditioning in Industry was extremely interested. While the Committee had been asked to consider forming a new Committee on Exhaust Ventilation, it was thought preferable to investigate all laws and codes now in effect applying to both exhaust ventilation and make-up air. The Committee on Research is carrying on this study in very active fashion through the Research personnel at the Society laboratory.

After the study has been completed, the Technical Advisory Committee on Air Conditioning in Industry will be in a position to proceed with recommendations and suggestions for codes and laws.

A study of information gathered to date had shown that many States had regulations for exhaust ventilation but failed to include air supply without which the system would not operate.

Carl H. Flink, Technical Secretary of the Society, stated that the Society had participated in the preparaton of at least 75 different codes and standards, many of which were concerned with the effect upon public health.

Histories of 75 codes had been prepared for the use of the Standards Committee and future code committees as a starting point for further committee action in bringing codes up to date. The Society has a right to be proud of its code activities in the past and an increased attention to preparation of codes and standards can be anticipated in the future.

President Downs announced that due to the unavoidable absence of the author he would present the paper, Mine Ventilation and Its Relation to Health and Safety, by D. Harrington (complete paper and discussion to be published later).

President Downs announced that the total registration for the Annual Meeting was 611, with 403 being members.

C. S. Leopold, Philadelphia, Pa., presented an abstract of his paper, Tobacco Smoke Control—A Preliminary Study (complete paper and discussion published in this issue, see p. 164).

Chairman Winslow called for the presentation of the paper, Noise Rating of Ventilating Fans, by W. H. Hoppmann and Fred Lager, New York, N. Y. Mr. Hoppmann presented an abstract of the paper. (Complete paper published in February 1945.)

R. D. Madison, Buffalo, N. Y. (Written): This paper emphasizes the value of standardization of fans and noise ratings conducted by the Navy Department. It also mentions the close cooperation existing between the Navy and the fan manufacturer.

You may be interested to know what your Research Committee is doing in respect to sound testing and sound test codes. Members of the Society are interested in two somewhat different types of fan installations, those with ducts and those without. For this latter case (unitary equipment) the S. P. O. method is particularly applicable. Generally, the units are not large and we are interested in the total energy and noise radiated from the unit. In the case of fans with inlet and outlet ducts the case is somewhat different. To know the total energy or noise is not sufficient unless it is separated into the two principal components (1) that radiated into the fan room and (2) that transmitted out through the inlet and outlet ducts. For this reason it is our plan to investigate both methods of test. As soon as personnel is available at the new Research Laboratory this project will get under way.

The chief criticism of the Navy and NAFM sound test codes is that they do not represent all types of fan installations. For example, a fan with both inlet and discharge ducts would have less sound radiated into the equipment room than one with discharge duct only. However, it would be doubtful if there would be much change in the amount communicated through the discharge duct. Probably the reduction in the amount radiated into the fan room would be now transmitted back through the inlet duct. Tests which we hope to make should throw some light on this point.

It is my opinion that a close correlation will result between the sound recorded by the method of test as outlined in this paper and the S. P. O. method.

Comdr. E. R. Queer, Washington, D. C., spoke of the work being done to obtain proper fan installations aboard ship to reduce noise. His talk was illustrated with slides.

C. M. Ashley, Syracuse, N. Y., expressed the opinion that the sound energy method described in the paper was a proper effort to obtain a fundamental method. From sound energy it would be possible to divide by absorptivity to obtain intensity of sound in a given space and from intensity it would be possible to convert to sound level. Such procedure had not been possible and the method used by the authors, therefore, represented a forward step in measurement and interpretation of the sound level of equipment.

Capt. T. H. Urdahl, Washington, D. C., expressed appreciation to the authors from the Bureau of Ships. The project of developing the fan test room was started for the purpose of eliminating the shipment of fans to the Navy laboratories for test and substituting, for this procedure, a standard test room of reasonable cost which manufacturers could build and in which fans could be tested and developed. By the use of a standard test room it would only be necessary to send personnel to the manufacturer's test room when approval of a type of fan would be requested.

Procedure for calibrating sound measuring instruments was being developed at the National Bureau of Standards.

Captain Urdahl expressed appreciation of the excellent cooperation given the Navy Bureau of Ships by the manufacturers of fan equipment.

President Downs then announced that the next order of business was the installation of the officers elected for 1945 and asked Past President W. T. Jones to preside at the Installation.

Installation of Officers

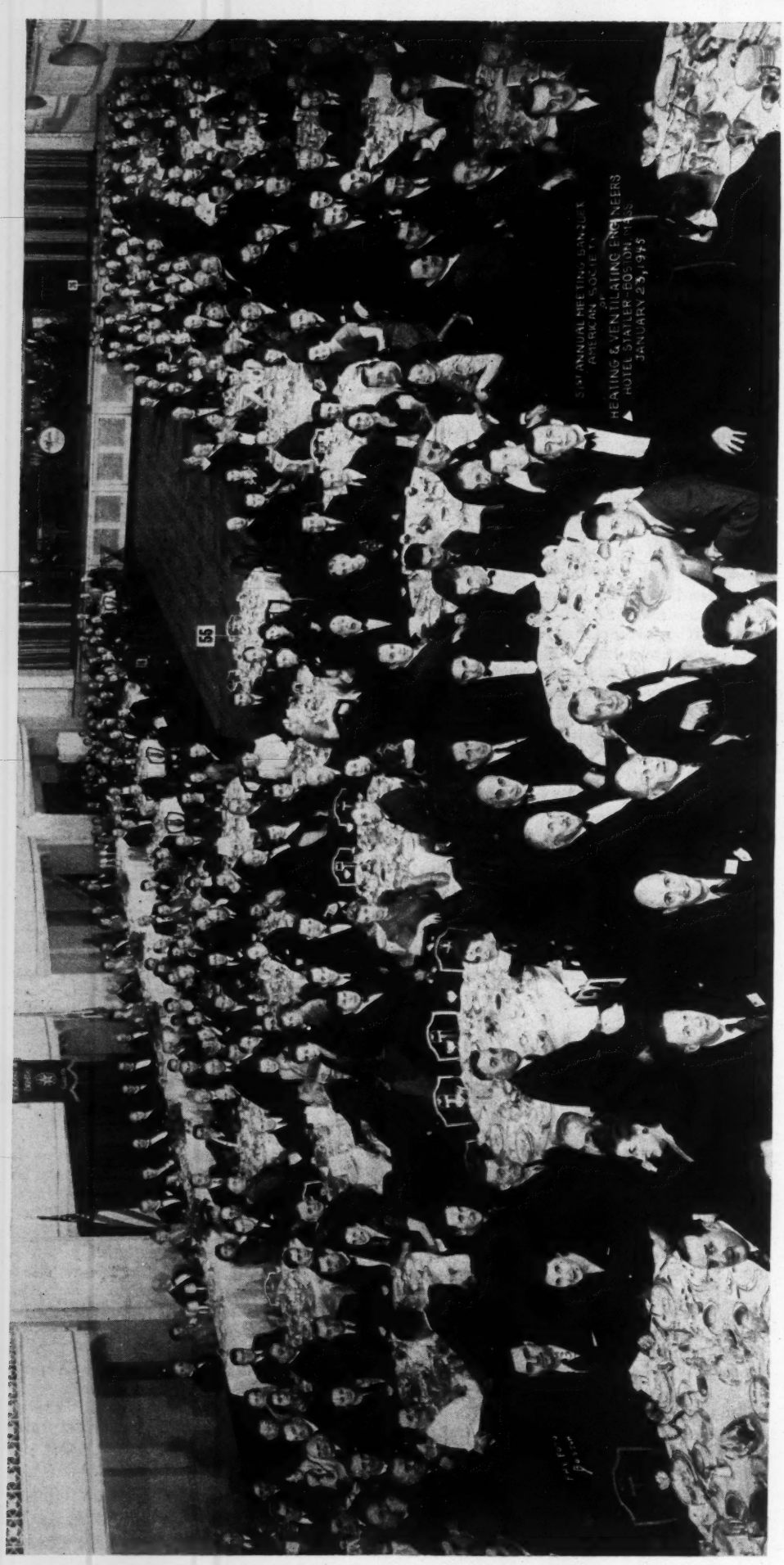
Mr. Jones asked C. V. Haynes, Past President, to escort Past President Homer Addams to the rostrum and then asked Mr. Addams to install the new President, Dr. C.-E. A. Winslow.

President-Elect Winslow made the following speech of acceptance:

"Mr. Addams, all I could hope for would be to carry on the traditions set by you and my other predecessors, and if that is successful it will be because of the staff of the Society, Mr. Hutchinson, Mr. Flink, Mr. Tasker, and the committee organization of the Society.

"In this year particularly that is important. We shall not have a summer meeting. We don't know whether we shall have a meeting next year, but we shall appoint this afternoon some 16 committees of the Society and of the Council. There will be between 25 and 30 technical committees associated with the Committee on Research, and that means that between two and three hundred members of the Society will be working on these various committees for the good of the Society throughout the year. I hope and believe that through that splendid service rendered by all the cooperating bodies the Society will be able to carry on through this difficult year."

Other incoming Society officers were installed as follows: 1st Vice-President A. J. Offner, by Past President W. H. Driscoll; 2nd Vice-President W. A. Russell, by



Society's 51st Annual Banquet
January 23, 1945
Hotel Statler, Boston, Mass.

Past President M. F. Blankin; Treasurer L. P. Saunders, by Past President W. H. Driscoll.

Past President W. L. Fleisher then installed the following newly elected members of the Council: Brig. Gen. W. A. Danielson, Memphis, Tenn.; H. R. Roth, Toronto, Can.; Ernest Szekely, Milwaukee, Wis.; and Dr. B. M. Woods, Berkeley, Calif.

Mr. Jones then declared the officers properly installed for the year 1945.

President Winslow referred to the breadth of interest shown in the subjects presented at the session and stated that they had ranged through the fields of vision in physics, optics, and acoustics.

T. D. Stafford, Grand Rapids, Mich., presented the report of the Committee on Resolutions, whereupon it was moved by L. P. Saunders, seconded by L. T. Avery, and

VOTED: THAT the following resolutions be adopted:

Resolutions

WHEREAS, our President, Sewell H. Downs, has, in the first year of the second half century of our Society's life, set a fine example of leadership in both technical guidance, and business management, and

WHEREAS, through his wise direction the Society's membership has been increased both in number and in unity of effort, and

WHEREAS, the Society's high standards so wisely established by his predecessors have been upheld and promoted by his steadfast adherence to them,

BE IT RESOLVED, the ASHVE extends its grateful thanks and deep appreciation to him and also to Mrs. Downs, for her inspirational loyalty.

* * * *

WHEREAS, the members of the Council, Advisory Council, Committee on Research, Technical Advisory Committees, and the Special Committees of ASHVE have not only carried on the work of the Society within their jurisdiction, but have been the instrumentalities through which the Society's knowledge and experience have been utilized in the prosecution of the war, and

WHEREAS, the time, effort and knowledge of individual members of these groups have been wholeheartedly given,

BE IT RESOLVED, that the sincere thanks of the Society be given to them.

* * * *

WHEREAS, some have made the supreme sacrifice,

BE IT RESOLVED, that the ASHVE extend greetings to those who still serve and deep sympathy to the families and friends of those who will not return, and

BE IT FURTHER RESOLVED, that a copy of this resolution be sent to the next of kin of those who have given their lives and who will continue with us in memory.

* * * *

WHEREAS, the Past Presidents of this Society have wisely and fruitfully laid the foundation stone on which we now build, and

WHEREAS, some have found it impossible to be with us at this meeting,

BE IT RESOLVED, that the members of the ASHVE make known to all of them our joy in having those with us who could attend, and our disappointment in not being able to greet those who were absent.

* * * *

WHEREAS, the finest traditions of New England hospitality have been upheld by the Committee on Arrangements of the Massachusetts Chapter at the 51st Annual Meeting of the ASHVE, and

WHEREAS, many individuals and organizations have contributed to the splendid success of the meeting,

BE IT RESOLVED THAT an expression of thanks and appreciation be adopted and copies of this resolution be sent to the following:

To Earl G. Carrier, General Chairman of Committee on Arrangements, and to his several Committee Chairmen, and their committee members, and ladies.

To authors for the interesting technical papers.

To various engineering Societies that sent representatives to establish the joint Inter-Society Committee on Psychrometry.

To William T. Jones, the Banquet Toastmaster.

To Prof. James Holt, Toastmaster of the Get-Together Dinner.

To the various members who assisted in furnishing registration personnel.

To the B. F. Sturtevant Co. for their courtesy in making the inspection trip possible.

To the organizations responsible for the Sunday afternoon broadcasts.

To the management and staff of the Hotel Statler for their courteous and excellent service.

To the newspapers and trade papers for their coverage of our 51st Annual Meeting.

Respectfully submitted,

RESOLUTIONS COMMITTEE
T. D. Stafford, *Chairman*
D. M. Allen
G. C. Kerr

As there was no further business, the 51st Annual Meeting was declared adjourned at 1:15 by Dr. Winslow.

Entertainment

Arrangements had been made by the Entertainment Committee, of which C. M. F. Peterson was chairman, for a number of interesting events beginning on Sunday, January 21. A. L. Hesselschwerdt, Chairman of the Ladies' Committee, took one group of members and ladies to visit Mrs. Jack Gardiner's Palace, a museum in which objects of art were exhibited and a musical program provided.

Another group of 80 members and guests attended a radio broadcast of the Boston Symphony Orchestra conducted by Arthur Fiedler.

On Monday morning the ladies were guests of Boston Chapter, with Mrs. E. G. Carrier as hostess, on a horse drawn covered wagon trip to points of historical interest in and around Boston.

A visit to the Agassiz Museum at Harvard University, arranged through the courtesy of Fred R. Ellis, provided interesting entertainment on Monday afternoon. The Ware collection of Blaschka glass models of plants and flowers which contains specimens illustrating 164 families of flowering plants, was of particular interest to the visitors.

The past presidents' dinner, which was attended by Homer Addams, M. F. Blankin, W. H. Carrier, W. H. Driscoll, W. L. Fleisher, E. Holt Gurney, C. V. Haynes, W. T. Jones, and J. F. McIntire, was combined with a Get-Together Dinner for members and guests on Monday evening. An authentic New England boiled dinner was served.

An unusual and thoroughly enjoyable entertainment feature was provided by a make-up artist, who selected well known ASHVE members as his subjects and proceeded to make them into various well known reputable and disreputable characters. Among the individuals selected for transformation were W. T. Jones, L. P. Saunders, Prof. James Holt, and D. L. Mills.

On Tuesday morning the covered wagon trip was repeated by popular request and Mrs. W. T. Jones acted as hostess.

Entertainment for Tuesday afternoon consisted of a bridge tea for the ladies. The winners during the afternoon were the following: Mmes. L. R. Szombathy, H. W. Wheller, E. A. Dusossoit, F. R. Ellis, and A. Ehrenzeller. Also Mmes. John Brinton, D. S. Falk, and F. D. B. Ingalls. Thirty attended and tea was poured by Mmes. D. M. Archer and J. C. Matchett.

Banquet

The annual banquet was held on Tuesday evening, January 23. In addition to the retiring president S. H. Downs and Mrs. Downs, the following newly elected officers and guests were seated on the dais: Pres. and Mrs. C.-E. A. Winslow, 1st Vice-Pres. and Mrs. A. J. Offner, 2nd Vice-Pres. W. A. Russell, Treas. L. P. Saunders, charter member and past president Homer Addams, Mr. and Mrs. W. T. Jones, Dr. and Mrs. W. H. Carrier, Mr. and Mrs. E. G. Carrier, Mr. and Mrs. D. M. Archer, and the speaker of the evening, Charles Winthrop Copp.

W. T. Jones acted as toastmaster and introduced each member seated at the head table. Short speeches were made by retiring President Downs, President Winslow, and Mr. Addams, who spoke briefly on the progress of the Society during the past 50 years.

The speaker at the banquet was Charles Winthrop Copp, a Vermonter and graduate of Oberlin College, who had been a teacher of English in Japanese government schools for two decades and who was imprisoned as a spy at the outbreak of the war. Mr. Copp was released by the Japanese in June 1944 and returned to the United States on the exchange ship Gripsholm. The speaker's subject was Japan Yesterday, Today, and Tomorrow.

Because of his intimate contact with the Japanese, Mr. Copp was able to analyze the actions of the Japanese and predict the reaction which might be expected from the defeat which was in store for them. Mr. Copp gave excellent descriptions of the modern improvements to be found in Tokyo and other large cities and emphasized particularly the contrast between the sections built in accordance with modern construction and the neighboring slums housing the population of cities such as Tokyo.

At the close of the banquet music was provided by Art Rubin's orchestra for dancing until one o'clock.

Tobacco Smoke Control – A Preliminary Study

By Charles S. Leopold*, Philadelphia

SUMMARY—An optical method is described for obtaining a reproducible smoke density scale against which can be checked observations on vision, eye irritation, and odor. Data obtained by this test method are submitted for the tobacco smoke conditions in Madison Square Garden.

HIGH TOBACCO smoke concentration in auditoriums in general, and in a sports arena in particular, results in interference with visibility, eye irritation, and certain odor effects.

The *interference with visibility* may be a direct obscuration of object viewed due to opacity of the intervening space, or a distraction and interference with vision due to the illuminated smoke cloud.

Eye irritation effects are: smarting and lachrymation.

Odor effects may be divided into: perception of odors upon entering the space, residual odors in clothing after leaving the space, and odors so pronounced as to be objectionable during occupancy.

Interference with vision is a function of the concentration of particulate matter, the distance from object viewed, and the physical relation of the lighting system, stage and seats.

Eye irritation depends upon the irritant concentration in the smoke and, with a simple ventilating system, is a function of the smoke density. Both fluid and particulate matter may contribute to eye irritation or the particulate matter may act solely as a conveyor of irritant gases or liquids. The smoke components may, and probably do, differ qualitatively and quantitatively in their effect on eye irritation and odor.

An electrostatic precipitator can remove a large portion of the particulate matter from smoke. As yet, we do not know how much of the eye irritant and odor producing substance is simultaneously removed.

Odor producing substances are similarly proportional to the smoke density. Charcoal adsorbers are effective in the removal of odor causing substance and have little effect in reducing fine particulate matter. An air washer with clean water will remove some odor but has little effect on fine particulate matter.

Dilution of the tobacco smoke by smoke-free outdoor air is effective in reducing all of the discomforts listed, but in year-round air conditioning systems, the amount of outdoor air required may prove economically excessive.

Where apparatus for smoke reduction is introduced in the recirculated air stream, the available apparatus, in general, does not deal equally with the three types of smoke difficulty. In speaking of smoke-free air as applied to a conditioning or ventilating system which utilizes smoke reducing apparatus in the recirculated air stream, it is necessary to differentiate between *particle-free, irritant-free,* and *odor-free air.*

Qualitative Observation at Madison Square Garden

For the seating and lighting arrangement used in the Garden, for basketball or boxing, and with fans delivering a limited quantity of outdoor air at a constant rate, without treatment other than heating, the smoke problem is presented as follows as the number of spectators increases: A general haze is quickly noticeable. The smoke becomes quite visible in the strong beam of the spotlights. Vision from the observer to the spectators at the far end of the arena, when viewed across the ring, becomes obscured. Awareness of the cloud in the spotlight becomes objectionable. Eye irritation is noted. In the practical range of ventilation, odor is not noticeable to the acclimated spectator, but it may be briefly noted by the patron entering the arena.

Selection of Test Method

Analysis of the problem indicated that a measurement of light transmission through the smoke cloud in an auditorium with a simple ventilating system would provide a reproducible scale of smoke density to which observations on visual discomforts, eye irritation, and odor could be referred.

Test Method

A narrow beam of light of constant intensity was projected diagonally across the arena as shown in Fig. 1 and the intensity of the beam at the end opposite to the projector was measured by photoelectric means. The receiving photoelectric cell was shielded so that it would not respond to light other than the projected beam.

Optical transparency is defined[1] as the ratio of the intensity of the

[1]The Principles of Optics, by Hardy and Perrin (McGraw-Hill); Photography—Principles and Practice, by C. B. Neblette.

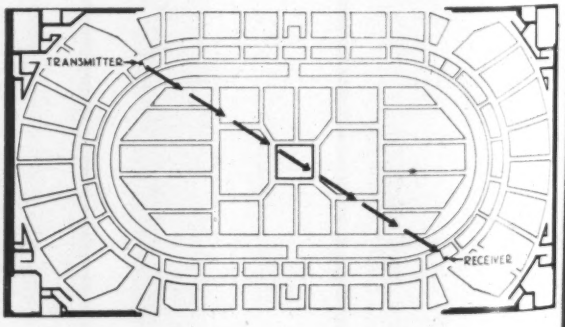


Fig. 1—Location of optical equipment

*Consulting Engineer. Member of ASHVE.

Presented at the 51st Annual Meeting of the American Society of Heating and Ventilating Engineers, Boston, Mass., January 1945.

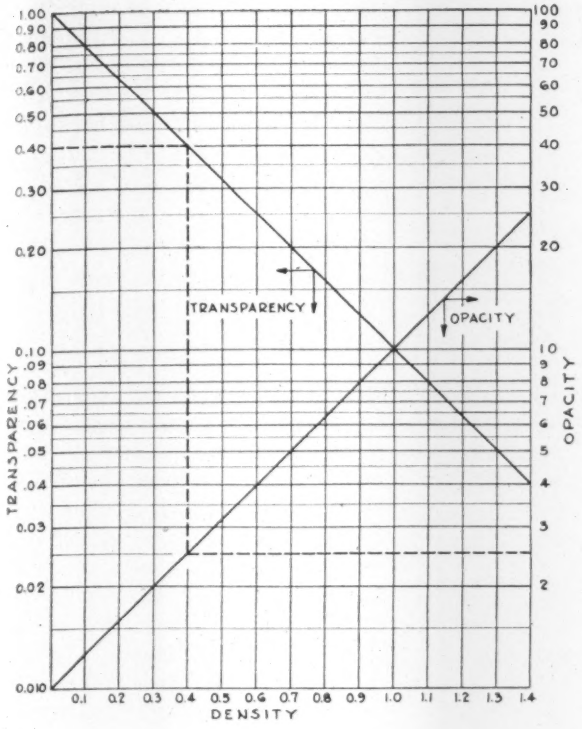


Fig. 2—Relation of density, opacity and transparency

transmitted light to that of the incident light. Within the scope of these tests transparency is used to denote the ratio of the transmitted light with a smoke cloud to the transmitted light without a smoke cloud.

Opacity is defined as the reciprocal of the transparency.

Density is defined as the Log_{10} of opacity, or Log_{10} of $\frac{1}{\text{transparency}}$.

The relation of transparency, opacity, and density is shown in Fig. 2. The concept is further illustrated in Table 1, in which the relationships are shown for a constant source of light passing through 0, 1, 2, and 3 equal light obstructions, each obstruction permitting the transmission of 10 per cent of the incident light.

The optical density of a smoke cloud is a function of the number and size of particles that the light beam encounters in passing from the light transmitter to receiver.[2] If it is assumed that the smoke cloud consists of particles of various sizes, uniformly distributed, the optical density becomes a function of the particles per unit volume. In an enclosure with uniform air distribution and uniform emission of smoke, the concentration of particles should be inversely proportional to the quantity of smoke-free air which is introduced. Thus, in comparing various constant rates of ventilation, the optical density would vary inversely as the cfm of smoke-free air per occupant.

The volume of the auditorium and number of air changes *per se* are of interest for an unsteady state, such as the initial build-up of a smoke cloud, or its decline, but not an important consideration in any steady condition, with the possible exception of the combination of extremely low air motion and low air change with light occupancy, in which case adsorption and settlement phenomena may be of practical magnitude.

Simplification of Field Tests

Since the optical density varies as $\frac{1}{\text{cfm per person}}$, it is possible to generalize that for any constant rate of smoke emission the relation of optical density to cfm per person can be plotted on logarithmic coordinates as a straight line parallel to Line 1 on Fig. 3.

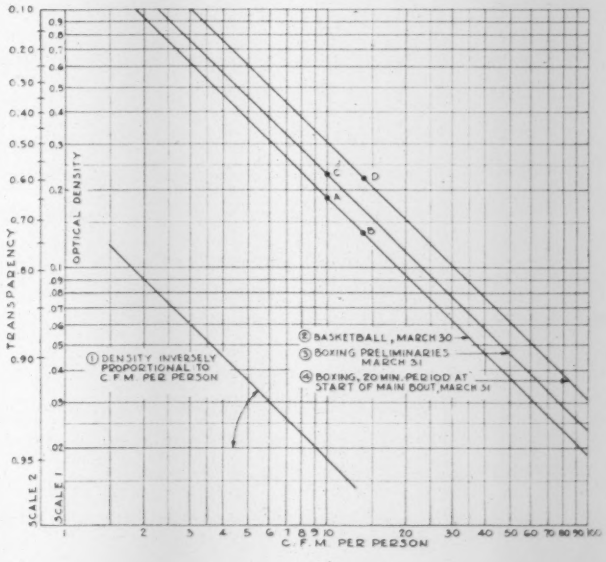

TRANSPARENCY
OPTICAL DENSITY
① DENSITY INVERSELY PROPORTIONAL TO C.F.M. PER PERSON
② BASKETBALL, MARCH 30
③ BOXING PRELIMINARIES MARCH 31
④ BOXING, 20 MIN. PERIOD AT START OF MAIN BOUT, MARCH 31
SCALE 2
SCALE 1
C.F.M. PER PERSON

Fig. 3—Variation of optical density and transparency with ventilation transmitter to receiver 240 ft

TABLE 1				
CONSTANT LIGHT SOURCE	A	T	O	D
→		1.00	1.0	0
→	□	0.10	10	1
→	□□	0.01	100	2
→	□□□	0.001	1000	3

A = EQUAL LIGHT OBSTRUCTIONS TRANSMISSION 0.10 EACH
T = TRANSPARENCY
O = OPACITY
D = DENSITY

This generalization simplifies the accumulation of test data as a reading at one sustained rate of ventilation, with a constant rate of smoke emission, is sufficient to establish the actual position of the line and thereby provide a means for predicting the optical densities and transparencies at other steady rates of ventilation.

Test Procedure

A description of the apparatus used is given in Appendix A. The location of the apparatus is shown in Fig. 1. The transmitter and receiver were located approximately 16 ft above the arena floor.

A conventionalized section of the Garden and air distribution is shown on Fig. 4. There are four supply fans on each side of the enclosure. The air discharge of the four systems on one side was obtained from pitot tube measurements. Delivery of the other four

[2]Transmission of Light Through Fog, by F. C. Breckenridge (*Transactions IES*, XXVII, No. 2, p. 216); the Stratten and Houghton formula (Physics Review, 38, 159, 1931).

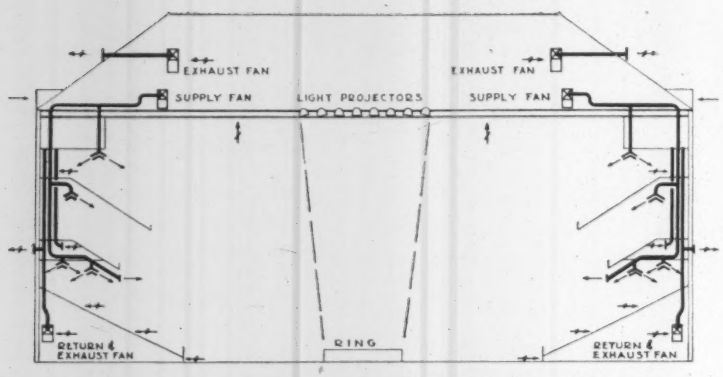


Fig. 4—Cross-section of Madison Square Garden indicating air distribution and lighting for boxing

symmetrical systems was estimated by a comparison of the static pressure in the supply duct just beyond the fan. Tests were conducted using all outdoor air, untreated except for filtering and heating. The fans, which are provided with 3-speed motors, were run at low and intermediate speeds in these tests. There are eight exhaust fans arranged symmetrically with the eight supply systems, and one additional exhaust fan at each end of the enclosure. All exhausts were operated in conjunction with supply in these tests. There was a slight positive pressure within the enclosure at all times.

Data were obtained for transparency during a basketball game and during a prize fight. In each case readings were started under a condition of light occupancy and continued at 10-min intervals for a short time after patrons had left.

Estimates of occupancy were furnished by the permanent personnel of the Garden and were in fair agreement. The maximum occupancy figures are accurate.

Impressions of conditions were noted by five individuals, one a non-smoker and one a heavy smoker. There was satisfactory agreement among observers.

The test data for basketball spectators is shown in Fig. 5. With maximum occupancy, two periods of constant transparency were obtained—one with 10 cfm per person and the other with 13.7 cfm per person. These points are shown as A and B on Line 2, Fig. 3. Within the accuracy of the experiment, the observed data corroborated the predicted relationship of cfm per person and optical density.

Fig. 5 shows the comparison of time, occupancy, and transparency. At 9:50 P. M., fan speed was increased so that the cfm per occupant was changed from 10 to 13.7. Comparatively little time was required to reach the new steady state of transparency. The test indicates that in the practical problem of combating the average maximum smoke density, the air change *per se*, or the lag of the auditorium, is of minor importance. It is of sufficient magnitude, however, to smooth out momentary changes in the rate of smoke emission which, there is reason to believe, occur at times of changing interest in the spectacle.

Fig. 6 is a graphical record of test data for boxing spectators.

Point C, Line 3, Fig. 3, shows the steady state for a peak crowd during the preliminary bouts. A short intermission preceded the main bout, at which time the ventilation was increased from 10 to 13.7 cfm per person. The increase of transparency, starting during the intermission, was quickly reversed at the start of the main bout and for a period of approximately 20 min the rate of smoke emission exceeded that which occurred during the preliminary bouts. The transparency, however, was somewhat improved due to the increased rate of ventilation. The condition for the steady state during the start of the final bout is shown by Point D, Line 4, Fig. 3.

Figs. 7 and 8 show the data of Fig. 3 on rectangular coordinates.

Figs. 3, 7 and 8 summarize the transparency or density to be expected at Madison Square Garden at a distance of 240 ft, at various conditions of steady occupancy and ventilation, when occupied by either fight or basketball spectators. The data pertain to the total number of spectators. Dependable data were not obtained as to the percentage of cigars, cigarettes, or pipes which were lighted, nor for the total number of smokers. A count of only 350 people during a fight indicated that less than 20

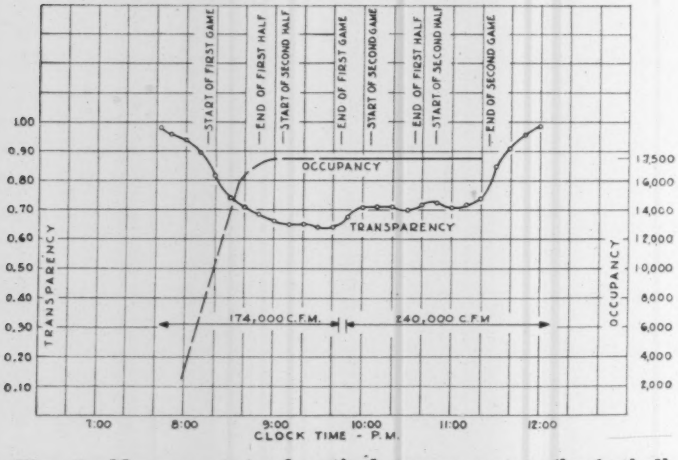


Fig. 5—Measurement of optical transparency (basketball program March 30, 1944)

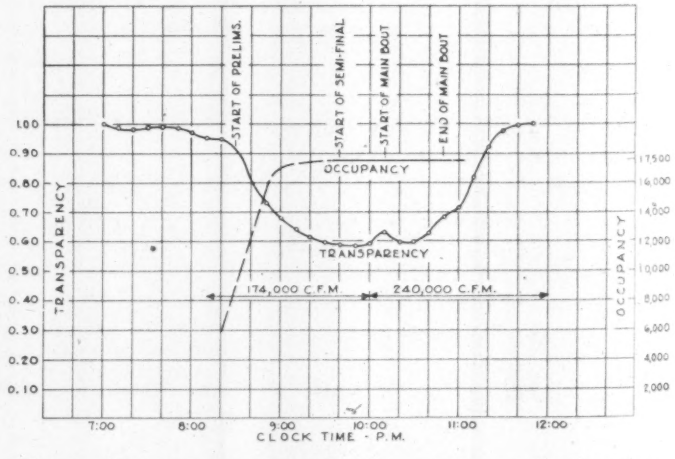


Fig. 6—Measurement of optical transparency (boxing program March 31, 1944)

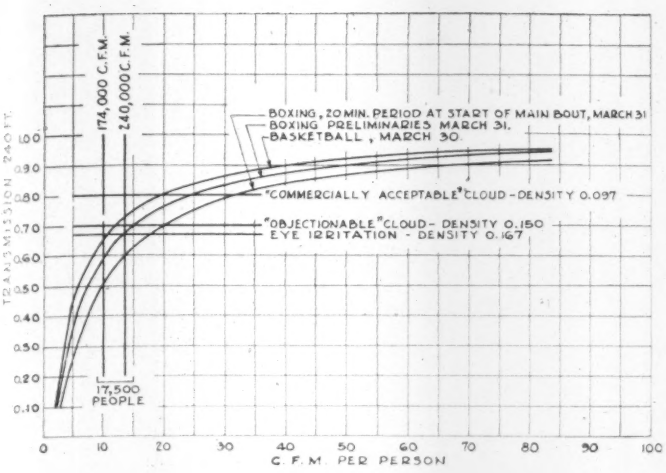

TRANSMISSION (240 FT.)
174,000 C.F.M.
240,000 C.F.M.
BOXING, 20 MIN. PERIOD AT START OF MAIN BOUT, MARCH 31
BOXING PRELIMINARIES MARCH 31.
BASKETBALL, MARCH 30.
"COMMERCIALLY ACCEPTABLE" CLOUD - DENSITY 0.097
"OBJECTIONABLE" CLOUD - DENSITY 0.150
EYE IRRITATION - DENSITY 0.167
17,500 PEOPLE
C.F.M. PER PERSON

Fig. 7—Variation of transparency with ventilation

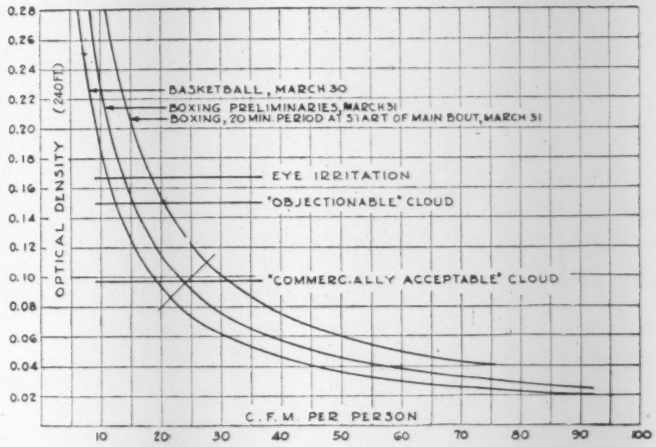

OPTICAL DENSITY (240 FT.)
BASKETBALL, MARCH 30
BOXING PRELIMINARIES, MARCH 31
BOXING, 20 MIN. PERIOD AT START OF MAIN BOUT, MARCH 31
EYE IRRITATION
"OBJECTIONABLE" CLOUD
"COMMERCIALLY ACCEPTABLE" CLOUD
C.F.M. PER PERSON

Fig. 8—Variation of optical density with ventilation

per cent had lighted cigars, cigarettes, or pipes. This figure is lower than the values usually assumed and indicates the desirability of further check.

During these tests the consensus of opinion of observers was as follows:

Eye irritation corresponded to a smoke density of 0.167 (transparency 0.675). The visible smoke cloud in the spotlights was judged as *objectionable* at a density of 0.145 (transparency 0.72) as viewed from the arena floor level and 0.670 when viewed from the projector location. Haze, though quite evident, was judged as *commercially acceptable* at a density of 0.097 (transparency 0.8) viewed from the arena. The estimate of *objectionable* is more definite than that of *commercially acceptable*. The qualification *commercially* indicates a compromise. Inspection of Fig. 7 indicates that progressive gains beyond 80 per cent transparency are achieved at rapidly increasing cost in cfm per occupant.

Unit for Comparison

The density scale of Fig. 3 was calculated from measurements of transparency at 240 ft. Optical density bears a lineal relation to the thickness of the medium and a unit density figure, such as density per foot, can be obtained by dividing the total density by the distance to which the measurement applied. This unit density can then be used for comparison in similar applications. Unit transparency would not be so convenient since transparency varies in a logarithmic relationship with distance.

Discussion of Visual Effects

A smoke cloud causes a decrease of light reaching the performer and a decrease in light reflected from the performer to the spectator. The resulting decrease in vision is relatively small at any rate of ventilation which would be adequate for the elimination of other forms of discomfort. Vision, similarly to other human senses, approximately follows the Weber Law[3] to the effect that the change in stimulus required to produce a noticeable change in perception is proportional to the pre-existing stimulus. This is frequently stated in the Fechner[4] form that perception is equal to a constant times the logarithm of the stimulus.

There is a very low level of illumination in the spectator space and any factor causing a decrease in vision would therefore be more noticeable when trying to discern detail across the auditorium than it would be in looking at the brightly illuminated center of interest. There is a further decrease in visual perception due to the light which is scattered from the spotlight beams competing with the stimulus from the center of interest. For very heavy concentration of smoke, decrease of light due to opacity may be of importance.

For reasonable ventilating rates, the most objectionable visual effect is the awareness of the smoke cloud. This visual effect may be partly of psychological origin but it is none the less real. The psychological factors involved are beyond the scope of this paper. The objectionable qualities of this effect depend on the angle formed by the line of sight and the line of the spotlights, and further on the depth of the smoke cloud through and beyond the center of interest. Thus, a spectator looking from the spotlight to the center of interest is less conscious of the cloud than is the spectator looking at right angles to the projector beam; and a spectator on the arena floor, looking across the ring the long dimension of the building, is more conscious of the smoke cloud than is a spectator looking across the short dimension of the building.

From the former observation it would follow that in a motion picture theater, where the sight line largely parallels the line of projection, smoke would interfere very little with vision and this appears to be the case. In motion picture theaters, smoke is quite evident in the beam if the observer looks across the beam rather than at the screen.

The smoke cloud in the Garden was appraised from various positions in the auditorium under a constant smoke density and constant illumination. In the order of decreasing visibility of the cloud, the points of observation were:

1. Lengthwise of the arena at ring level.
2. Crosswise of the arena at ring level.
3. Crosswise of the arena at mezzanine level.

[3]The Science of Seeing, by Luckiesh and Moss.

[4]Handbook of Engineering Fundamentals, by Eschbach.

4. Any position from the top balcony.

Lighting projectors are uniformly placed above and beyond the outline of the ring and the basketball court. For this illuminating system it appears that if smoke density is held at a level which will not produce an objectionable light beam for patrons looking at right angles from a distance of approximately 100 ft, it will not be objectionable for patrons in the high gallery who have a total sight line of approximately 220 ft. When viewing from any point other than the arena level, the spectator looks down at the relatively bright floor of the ring and immediate surroundings. When looking across the ring from the arena level, the background of the fighters is the smoke cloud against the relatively dark house. As the density of the cloud approaches an *objectionable* condition it is not possible to distinguish detail in the stadium seats beyond the arena when looking lengthwise through the house. Polarization[5] of the scattered light was noted by direct observation with a polarizing filter.

Discussion of Eye Irritation

Previous experiments[6] have indicated that eye irritation is a function of irritant concentration. It would, therefore, be expected that the smoke density at which eye irritation was noted in these experiments would be a constant applicable to other work.

Discussion of Odor

The odor problem in the Garden may be subdivided into:

Odor for the acclimated spectator;

Odor for the spectator entering the house;

Odor remaining in the clothes.

Due to rapid olfactory fatigue, there is no practical problem of odor for the acclimated spectator. An odor must be indeed objectionable to a person entering the auditorium to be even perceptible to a spectator who has been inside for a short time. Any quantity of outdoor air which will assure satisfactory visual effects will avoid objectionable odor for the acclimated spectator. It could be of importance in an extreme case, such as the use of a very small quantity of outdoor air in combination with some form of apparatus in the recirculated air system which would remove the visually objectionable smoke without the removal of the odor-causing substance.

A patron going to his seat must first pass through a ventilated lobby. As a rule, smoke concentration in a lobby is somewhat less than in an auditorium, though this condition can at times be reversed. If there are two steps of increasing smoke concentration, odor perception is minimized by the relation of change in stimulus to the pre-existing stimulus and rapid olfactory fatigue.

The factors affecting the odor of tobacco remaining in the clothes have not been adequately investigated. The relative importance of smoke density, time, temperature, and water vapor is not known, either for the period of exposure or for the period which follows.

Limitations of the Data

The analysis assumes a uniform distribution of smoke and smoke-free air. Smoke appeared uniform when the house lights were on and the spotlights were off. No actual measurements were made of the uniformity of smoke or the specific air supply directed toward the ring.

Tests were conducted for the illumination normally used for basketball and for boxing. Experiments were not conducted on the effect of variations in light intensity, either of center of interest or of background.

Four of eight fans were accurately tested at two speeds. Total air quantities should not be depended upon for an accuracy of better than plus or minus 10 per cent. Variation in capacity between the two ventilating rates was confirmed by static pressure readings at all fan discharges and should be accurate as a ratio.

The data represent two evenings of measurement preceded by one preliminary afternoon test. Data appear consistent but, as noted, the period of test was limited.

The specific data of these tests, in general, cannot be safely extended to enclosures with different types of occupancy and different physical arrangements. The test method outlined is relatively uncomplicated and convenient for use in the field. Additional data will be useful and it is suggested that any data subsequently collected be forwarded to the ASHVE Research Laboratory to help fill the general void on this subject.

Acknowledgment

The Precipitron Application Department of the Westinghouse Electric Elevator Co. cooperated in these experiments by providing the optical equipment and the assistance of H. W. Wrigley, Laboratory Supervisor, during the conduct of the tests.

Appendix A

Description of Equipment

The projector consisted of a Westinghouse S No. 787917 Portable Traffic Signal Projector with all unnecessary parts, including handles and switches, removed so that only the housing, lamp and socket, back, primary and secondary reflectors remained. A bow and base capable of being rigidly clamped were added for convenience in mounting. A No. 1503 lamp, 50 candle, 6-8 volt, was used as a light source. With this lamp in focus in the reflector, a narrow beam of light was obtained having a spread of approximately 1½ deg and an intensity of approximately 500,000 candlepower.

The receiver consisted of two selenium type self-generating barrier layer cells mounted in the same type housing as the projector, with two baffles with circular openings adjusted in front of the barrier layer cells inside the housing so that the effective field of view of the cells was limited to a circular area centered at the projector.

The barrier layer cells in the receiver were connected in parallel to a high sensitivity microammeter.

Both the projector and receiver were bolted solidly to sloping steel-surfaced banisters in such a position as to be not readily accessible to spectators. The operators occupied the seats alongside. The location was such that as few people as possible were disturbed by direct light from the projector and no light from any fixture in the building could enter the

[5] Fragments of Science, by John Tyndall.

[6] Noxious Gases, by Henderson and Haggard (Reinhold Publishing Corp.).

receiver and produce an erroneous reading.

To make the tests, the projector was focused to produce as nearly as possible a perfectly collimated beam of light, the maximum intensity of which was directed against the barrier layer cells. The sensitivity of these cells was then adjusted to give approximately two-thirds scale deflection of the microammeter when the air in the building was as clean as possible. The lamp in the projector was operated from a constant-voltage transformer in order to maintain constant light output. Readings of the light intensity reaching the receiver were made every 10 minutes throughout the test period by turning on the projector, allowing 30 seconds operation for the light intensity from the projector to become stabilized, and then recording the meter reading. The projector was turned off between readings in order that the spectators might not be disturbed any more than necessary.

Discussion

C. A. Atherton[7], Louisville, Ky. (written): In general I agree with the author's discussion of visual effects. I believe, however, that the introduction of the Weber-Fechner Law is unnecessary and confusing. The effect on vision of the surrounding glare from the dispersal of light by the smoke is much more important than is the variable brightness of the objects viewed; from an illuminating engineering point of view this veiling glare is very important indeed. It is a problem similar in nature to that of trying to see through a fog by the light of automobile head lamps. It is interesting to note that the light is polarized, but probably no practical advantage can be taken of this fact.

The variation of visibility due to the background brightness; the fact that from some directions vision is by silhouette; and the greater weight which the author places on the distracting annoyance of the bright cloud of smoke rather than on variations in visibility; these are the sort of things an illuminating engineer would like to see investigated further.

It is unfortunate that only one condition of lighting was considered. Undoubtedly the lighting in the Garden is excellent, but I wonder if it has been investigated from the point of view of visibility through clouds of illuminated smoke. The author's field is that of getting rid of the smoke. Mine is that of producing lighting for good visibility. We look at every problem from two different points of view, but agree nevertheless in a large degree. At least in our two fields of engineering there must be cooperation in order to arrive at the best and most economic solution. I congratulate the author upon bringing the two together.

[7]Reynolds Metals Co., Parts Div. (Member of IES).

As an illuminating engineer I note also at once that although the *commercially acceptable* transmission factor under the circumstances of the test was agreed to be 0.80, the transmissions actually observed during the game and match were considerably below that. This has a very familiar ring to the lighting man who talks of 50 or 100 footcandles as his *commercially acceptable* intensities, but finds most installations giving 10-15 footcandles of intensity. It is curious how similar all such problems are in their fundamentals. So often we know how to do things much better, but we do not know how to get the people to adopt these better methods.

F. H. Munkelt, New York, N. Y. (Written): This excellent approach to a quantitative determination of tobacco haze and its control by ventilation makes interesting study. That it was applied to an unusual structure does not detract from its value. There is, at least, symmetry and there are within the building no interfering barriers, corners or partitions which often qualify the value of tests in smaller structures when air distribution is a factor.

It is now about 10 years since I first tried to analyze the problem of removing tobacco contamination from the air. It is, therefore, indeed refreshing to have this paper appear. The conclusions which I reached at the time were very simple: that the solution of the problem consists of two parts, first, the removal of the smoke particles and second, the removal of a certain vapor or vapors. My views today are substantially the same although they have been modified somewhat in detail.

The author has distinguished between eye irritation and odor. It is assumed that he has not precluded the possibility of both being caused by one substance. Experience with the tobacco problem points to the conclusion that both the major irritant and the major odor present are characteristics of the vapor of pyridine. Other substances with one or both of these characteristics may be present, but certainly in much lower concentration.

Pyridine is a liquid with a most pungent odor which, in dilute state, resembles the odor from stale cigars. Its toxicity is reported[8] as "local irritation on the mucous membranes and a general narcotic action on the nervous system. Symptoms following exposure are irritation of the respiratory tract and of the eyes, and cough."

Tobacco contains nicotine, which is a very poisonous oily liquid. Nicotine is a bi-cycle molecule, one cycle of which is identical with the pyridine ring. Reducing the mechanism of smoking a cigar to its simplest terms, the heat of the lighted end evaporates some of the nicotine, and at the same time dissociates some nicotine to produce pyridine. Presumably a large fraction of both these high boiling vapors are condensed in the lower part of the cigar, causing it to become ranker as it becomes shorter, and leading our physicians, when they find it necessary to regulate individual smoking habits, to warn against smoking cigars more than half way. Pyridine is the more volatile of the two and would be expected to be the predominant vapor in mixture with the smoke.

[8]The Analytical Chemistry of Industrial Poisons, Hazards and Solvents, by Morris B. Jacobs. (Interscience Publishers, Inc., 1941.)

The irritant level has been determined by the author in terms of smoke density. It is customary to express vapor concentration in terms of parts per million or milligrams per litre. However, in the case of smoke and vapor emanating from the same source expressing the irritant level in terms of smoke density may be entirely satisfactory as the following general observations will indicate. These are not tests which I have made or which I have found reported anywhere. They come out of my studies in the field of sorption of gases and vapors by solids and they certainly indicate the overlapping nature of the smoke and vapor present in cases of this kind. When a substance is burned, gases, vapors and fine particulate matter called smoke are produced. Of course, in some cases, the quantity of one or two of these products could be zero. The smoke particles, largely carbonaceous and produced under conditions of heat, are active adsorbents to a greater or less degree. Any adsorbent will retain a certain minimum amount of a given vapor under most conditions except that of increased temperature. Placed in a high concentration of the same vapor it will adsorb an excess of the vapor. That leads to the belief that the smoke particles adsorb, as soon as cooled and while still not far from the source of combustion, an excess quantity of the vapor having the characteristic odor of that combustion, and then release the excess slowly after the surrounding concentration has been dissipated. It is one way that the lingering odor of hydrogen sulphide or sulphur dioxide in soft coal smoke can be explained. It is one way that the lingering effect of the odor of pyridine in tobacco smoke can be explained.

If there is any sense at all in the adsorptive nature of smoke, it serves to emphasize the necessity of removing both the tobacco smoke and the irritant vapor of pyridine, if satisfactory conditions are to be maintained. According to Fig. 7, from the paper, some additional ventilation was needed in a few cases to reach the eye irritation maximum density and considerably more ventilation in all cases to reach the *commercially acceptable* density. In problems where recirculation is indicated, satisfactory means are available for removing the smoke particles. The pyridine vapors can be removed by adsorption by activated

carbon as shown by tests made in the laboratory with a duct in which an electrostatic precipitator was installed and a bank of activated carbon canisters was located downstream. When the precipitator was in service and the canisters were removed from the duct the smoke was completely arrested but the odor came through with little, if any, noticeable reduction. When the precipitator was turned off and the activated carbon canister placed in the line, the smoke came through in volume but the odor concentration was very low. When both precipitator and canisters were in service a very satisfactory job was done in removing both smoke and odor. The adsorption properties of pyridine by activated carbon are not far removed from those of benzene, a substance which resembles pyridine in chemical structure. It should be stated that, in the majority of problems which have been reviewed involving tobacco cases with insufficient ventilation, the owner emphasizes the eye irritation condition more often than the haze.

The author reports the same occupancy for basketball nights as for boxing nights. That is a little surprising because the entire central arena is occupied on boxing nights and very little, if any, of it on basketball nights. Probably, in both cases the Garden was not filled to capacity. Regardless of the reason for equal attendance, one thing is certain. On the boxing night, there was much smoking directly under the light beam, but there was none on the basketball night. And might not this have accounted for the lower optical transparency at the beam level as recorded in Fig. 6 and compared with Fig. 5? Will the author state, in this connection, if he observed a tendency for new smoke clouds to linger over the heads of patrons seated in the arena? In the not too distant past, inability to obtain a clear view of the ring has been an objection on the part of spectators in that section. The air distribution may, however, have been improved since.

It is hoped that the author will continue his studies along the simple and ingenious lines here described. As he has said, the data secured cannot be safely extended to other types of structures. The ventilation used, in terms of cfm per occupant, is lower than any values that have seemed proper for tobacco smoking conditions. Correspondingly, the resulting smoke densities leave something to be desired. It will be interesting if the author, in his future work on this subject, will include some smaller structures and in so doing point out what differences there may be in the amount of ventilation required on a large structure like Madison Square Garden, and that required on a structure of ordinary dimensions, for equal results, all other conditions such as space per occupant and cfm per occupant being substantially the same.

G. W. Penney, East Pittsburgh, Pa. (written): I think that the author is to be commended for starting a new type of investigation and for quickly publishing information to give engineers data on a subject on which nothing has been available. The quantitative increase in smoking between a basketball game, the preliminary bout, and the main bout is very interesting and useful.

I hope that the author is successful in stimulating further work by the Society. He is suggesting a new technical advisory committee to promote more extensive work. I hope that this suggestion is carried out.

As Mr. Leopold suggests, a large number of additional tests are needed to obtain similar data on other sports events, night clubs, restaurants, etc. Madison Square Garden provided an excellent place for this particular method of testing because the space is large so that the light beam can be long, giving a large percentage of light absorption. However, we may be able to reflect a light beam several times across a smaller room so as to get a reasonable light absorption and adapt this method to smaller rooms.

These tests were based on using outside air which was sufficiently clean to give a negligible light absorption. However, in many cities there are many "smoggy" periods when the outside air is so polluted with soft coal smoke as to give poor visibility in large rooms, even with all outside air and no tobacco smoke. In more extensive investigations, therefore, the cleanliness of the outside air must be considered.

As the author has suggested, another important subject is the purification of smoke-laden air so that it can be recirculated to permit maintaining good atmospheric conditions in auditoriums and similar buildings without the excessive heating and cooling that is required if all outside air is used for ventilation.

C. M. Ashley, Syracuse, N. Y., suggested that evaluation of the number and activities of smokers should be an interesting subject for further observation because evidently Mr. Leopold had found many present impressions to be erroneous.

In smaller spaces Mr. Ashley believed the problem of visibility would be less acute but that eye irritation and odor would be of primary interest.

H. C. Murphy, Louisville, Ky., referred to the work of Mr. Leopold and his brother, Dr. Solomon Leopold, about 20 years ago in providing a procedure for relief of hay fever, bronchial asthma, and similar allergic disorders by means of air cleaners. Many economies in manufacturing processes were effected by the procedure for obtaining air relatively free of air-borne allergic bacteria, spores and air impurities. The same attention had not been applied to air cleanliness in workshops and places of public assembly because the economies were not so apparent.

Mr. Murphy stated that while electric air cleaners were effective in removing particulate matter, smoke and fumes, there was at present no adequate method of determining the effectiveness of removing odor and eye-irritating substances from air. It was hoped, he said, that the Society would intensify its study of adequate odor measurement standards and procedures.

L. T. Avery, Cleveland, Ohio, expressed appreciation of Mr. Leopold's paper in outlining a method for measuring smoke which could be used in smoky atmospheres and hoped the instruments for the purpose would be developed rapidly.

No method of measuring oil mist is available, said Mr. Avery. Visual observation in a long narrow building may indicate a high concentration which is really an optical illusion.

A smoke measuring instrument would be of particular value in a foundry where the dust count may vary considerably and where a low dust count may accompany a high smoke density appearance.

Mr. Avery suggested that ventilation from above caused the smoke to pass through the space in which the occupants were seated and therefore did not reduce the odor effect on clothing but that if ventilation air were introduced to pass through the audience the odor effect on clothes would be nil.

In certain foundry air conditioning installations Mr. Avery had noticed that ventilation applied at the top would blow the smoke and gases downward upon the workers.

Chairman Downs remarked that the Society Technical Advisory Committee on Instruments seemed to be involved in the discussion.

Author's Closure: Mr. Leopold remarked that his paper was based upon a private investigation conducted with the aid of H. W. Wrigley, Westinghouse Electric Elevator Co., which provided the instruments used. Further experimentation should perhaps be undertaken by others who are interested.

In reply to Mr. Munkelt, Mr. Leopold stated that the difference in seating between basketball and boxing contests was about 600 seats placed in the arena for boxing. Pipes seemed to predominate over cigars in quantity used.

The removal of smoke required at least 15 and more cfm of outdoor air.

While many changes would be possible in the lighting as well as color used on walls, no consideration was given to these features. They were accepted as they existed. The matter of lighting was considered to be within the field of the illuminating engineer and was avoided by the author.

The author agreed with Mr. Penney that in certain cases outdoor air was unsuitable for use and it was, therefore, necessary to employ 100 per cent recirculation to eliminate smarting of eyes.

W. E. LELAND, LIFE MEMBER, DIES ON COAST

Word has been received of the death of William E. Leland, Consulting Engineer and Life Member of the Society, on January 11, 1945, at Providence Hospital, Oakland, Calif., after a six weeks illness.

Mr. Leland was born in Framingham, Mass., on May 4, 1870. He attended public schools, including high school, in Framingham, and was graduated from the Massachusetts Institute of Technology, Boston, in 1891 with a B.S. degree in mechanical engineering.

From 1891 to 1895 he was employed as draftsman in the factory of the B. F. Sturtevant Co., Jamaica Plain, Mass., and in 1895 he was employed by Babcock and Wilcox Co., New York, N. Y. After a year he left that company and became engineer with Alfred R. Wolff, Consulting Engineer in New York City, where he remained until 1899. He then worked as Inspector of mechanical equipment in the Supervising Architect's Office, U. S. Treasury Department.

In 1906 he established his own office in San Francisco as Consulting Mechanical Engineer, and in 1914 joined into partnership with Harry S. Haley, and until his death was senior partner in the firm of Leland and Haley, Consulting Mechanical Engineers, after devoting 40 years to consulting work.

The State of California employed Mr. Leland's services from 1914 to 1940 as Lecturer in Architectural Mechanics at the University of California. He was also employed by the Golden Gate International Exposition from 1936 to 1939 as Chief Mechanical Engineer.

Mr. Leland joined the Society in 1915, and in 1941 was elected to Life Membership. He took an active interest in the establishment of the Society's Research Laboratory 25 years ago, and was also active in the work of the Golden Gate Chapter since its organization in 1937.

Mr. Leland was responsible for the design of mechanical equipment in a great many well known buildings on the Pacific Coast.

Besides holding membership in the ASHVE, Mr. Leland was also a member of the American Society of Mechanical Engineers and the Rotary Club.

He is survived by his widow, a son, Wallace, of the United Air Lines in New York City, and his granddaughter, Eleanor Ann, to whom the Officers and Council of the Society extend their deepest sympathy.

H. B. LAUER DIES IN ACCIDENT ON COAST

The accidental death of Harold B. Lauer occurred on January 3 when he was involved in an automobile collision. Mr. Lauer was Vice-President of English & Lauer, Inc., 1978 S. Los Angeles St., Los Angeles, Calif., and had specialized in heating, ventilating, power plant and air conditioning work. Mr. Lauer was born in Chicago March 1, 1895, and had been a resident of California for many years.

His first engineering experience was obtained in the mining field when he was employed by the Ray Consolidated Copper Co., and the Utah Copper Co. After service in the United States Army in 1918 and 1919, he joined the firm of George B. Larimer and from 1923 to 1927, was with the firm of Larimer and Lauer, Inc. He acted as sales engineer, specializing in heating, ventilating and air conditioning equipment.

In 1927 Mr. Lauer joined Harrold B. English, partner in the firm of English and Lauer, Inc. Mr. Lauer became a member of the Society in 1935 and was active in the Southern California Chapter where his loss will be keenly felt. Mr. Lauer leaves a widow, Mrs. Eva Lauer, a daughter, Lorraine, and his mother, Mrs. Mae Lauer, to whom the Officers and Council of the Society extend their sincere sympathy.

Funeral services were conducted at Forest Lawn Memorial Park on January 8.

H. N. KITCHELL, RETIRED HEATING ENGINEER, DIES AT 85

Herbert N. Kitchell, Cincinnati, died in the Ridge Rest Home, Pleasant Ridge, on January 2, 1945. Mr. Kitchell was born in Chicago, Ill., on May 2, 1860.

Mr. Kitchell was one of the first Cincinnatians to own a high-wheeled bicycle and a steam automobile. He was associated with the Crane Co. for 45 years until his retirement in 1933.

Mr. Kitchell had been a member of the Society for over 12 years prior to his retirement from active business. He also held membership in the Scottish Rite and Shrine, Clovernook Country Club and the Cincinnati Club.

He is survived by three brothers, Charles Kitchell, Cleveland; Joseph Kitchell, Los Angeles; and Larence Kitchell, Seattle, Wash.; a sister, Mrs. Robert Blakeman, Indianapolis; a son-in-law, Dr. F. J. Boyd, Cincinnati, and two grandchildren, Dr. F. J. Boyd, Jr., Indianapolis, and Mrs. Marion Eanes, Cincinnati, to whom the Officers and Council of the Society extend their deep sympathy.

S. B. STROUSE DIES IN ATLANTIC CITY

According to word received recently, Sidney B. Strouse, Atlantic City, a member of the ASHVE since 1921, passed away on January 23, 1945.

Mr. Strouse was born on February 23, 1883, at Philadelphia, Pa. He attended the Central Manual Training School and the Engineering Department of the University of Pennsylvania.

His first experience was obtained when he was employed by the Bell Telephone Co., Philadelphia. He became a member of the firm of the Pennsylvania Engineering Co., and engineer for the Philadelphia and Western Ice Mfg. Co., Cardington, Pa. During this time he was in charge of design, construction and installation of power, heating, ventilating, refrigerating and ice making plants.

Mr. Strouse also spent three years in special studies in physics and advanced mathematics, and in 1915 he became district manager of Warren Webster and Co. Some of the installations for which Mr. Strouse was responsible are Frank H. Fleer Co., Inc., Toronto, Canada; U. S. Paper Box Co., Philadelphia; Western Ice Mfg. Co., Ventnor City School, Ventnor City, N. J., and the Municipal Hospital,

Atlantic City, N. J. In 1921 he opened up his own office as an electrical and mechanical engineer in the Guarantee Trust Building, Atlantic City, N. J.

Besides being a member of the Society, Mr. Strouse was also a member of the *ASME*.

The Officers and Council of the Society extend their sincere sympathy to the members of his family who survive.

NEW YORK CHAPTER LOSES MEMBER

Word has been received of the sudden death of Frederic W. Phillips, heating and ventilating engineer with the Queens Borough Gas & Electric Co., Far Rockaway, L. I., on February 17. He was born February 23, 1895, at Ithaca, N. Y.

During the first World War he wrote a thesis on the "Effect of Explosions on Trees" based upon his own observations, and as a result received his master's degree in forest engineering from the New York State College of Forestry.

He was in charge of the heating plants and grounds of the Madison Barracks, N. Y., while he was serving in the U. S. Army in 1917 and 1918. Following his discharge from the Army, after the war, he became draftsman for C. W. Short, New York architect, and late in 1919 he became estimator and engineer for E. W. Mandeville, Inc., Brooklyn, N. Y., where he remained until 1933. He later joined the staff of the L. J. Mueller Furnace Co., New York, N. Y.

He joined the Queens Borough Gas & Electric Co. in August 1936, which position he held until his death. He was in his office the day preceding his death. In 1941 he was appointed one of the industrial specialists with the War Production Board, Oil Conservation Department.

Mr. Phillips will be missed by his associates in the New York Chapter and by his many friends in the heating and ventilating field.

He is survived by his widow and a son, Alfred, who is serving in the U. S. Army overseas, to whom the Officers and Council of the Society extend their sincere sympathy. Burial was in the family plot in Ithaca, N. Y.

SUMMARY OF LOCAL CHAPTER MEETINGS

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Atlanta	Jan. 15	Problems Confronting the Unit Heater Industry	Mr. Downey, Pres., Industrial Unit Heater Association	Change in meeting night was discussed	40	0.75
	Dec. 11	Business Meeting	Election of Officers: Pres., I. B. Kagey; Vice-Pres., W. J. McKinney; Secy., M. F. DuChateau; Treas., E. R. Ross	Reports were submitted by Messrs. Frank Lawrence, C. L. Templin, John Rittelmeyer, T. T. Tucker	14	0.25
Central Ohio	Feb. 12	Forced Hot Water Heating	R. E. Moore, Bell & Gossett Co., Morton Grove, Ill.	Illustrated his talk with lantern slides	50	0.61
	Jan. 15	The Place of Coal in Post-War Heating	R. A. Sherman, Battelle Memorial Institute, Columbus, Ohio	Secy. A. W. Williams reported 50 on Chapter's roll	34	0.68
Connecticut	Jan. 10	Radiant Heating	Lorenzo Hamilton, R. Vanderweil, and K. C. Woodward, Development Dept., Chase Brass & Copper Co., Waterbury, Conn.	Discussion followed	143	4.5
Delta	Jan. 12	Dehumidifying of Air with Coils	Prof. William Goodman, Illinois Institute of Technology, Chicago	Interesting question and answer period followed	53	0.49
Illinois	Jan. 8	Control Indoor Climate	P. B. Zimmerman, Pres., Indoor Climate Institute and Vice-Pres., Airtemp Div., Chrysler Corp.	Committee reports were given by Messrs. Kearney and Ericsson	80	0.51

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Memphis	Jan. 8	Business Meeting	Pres. J. J. Nolan appointed several standing committees	By-Laws and Rules as amended were adopted	18	
Michigan	Feb. 12	Control of Industrial Atmospheres	W. N. Witheridge, Detroit, Mich.	W. H. Old reported on the Annual Meeting in Boston. Mr. Durks spoke for the American Red Cross	67	0.61
	Jan. 15	Panel Discussion of District Heating	Board of Experts: Messrs. Dubry, Foulger, Tuttle and Winans	Mr. Dubry acted as coordinator. A lively question and answer period followed A movie "Two Girls and a Sailor" concluded meeting	102	0.95
Montreal	Jan. 11	Air Sanitation	O. G. Moffat, Mgr., Air Conditioning Div., Canadian Westinghouse Co., Ltd.	Treas. Dykes submitted the final financial report	37	0.50
Nebraska	Feb. 6	Engineered Btu's in Politics	Brig. Gen. W. A. Danielson, Memphis, Tenn.	Guests included several from U. S. Engineers and Repair and Utilities Div., 7th Service Command	28	
	Jan. 19	Radiant Heating	F. W. Hutchinson, University of California, Berkeley.	Messrs. W. F. Schollman, pres. of Omaha Master Plumbers, and W. M. Scott, pres. Nebraska Plumbers Assn., attended	45	
New York	Jan. 15	Development of Liquid Fuel Burning Heaters for the Aircraft Industry	R. A. Bell, Mgr., Aircraft Heater Div., Surface Combustion	Pres. Koehler announced appointment of Chapter Nominating Committee with W. E. Heibel, Chm., Messrs. Bond, Oakes, Pabst and Wheeler	90	0.42
		Development of the Anthratube Principle of Combustion	Allen J. Johnson, Anthracite Industries Laboratory, Primos, Pa.			
Northern Ohio	Jan. 8	Instruments Used to Measure Air Velocities Engineering to Please the Customer	G. B. Priester, Case School of Applied Science, Cleveland G. L. Tuve, Chairman of Research Committee ASHVE	Cyril Tasker introduced J. C. Pritchard, Ministry of Fuel and Power, and R. H. Rowse, Fuel Research Board, London, England	71	0.69
North Texas	Jan. 15	Business Meeting	Pres. Gessell announced appointment of committees; Program, Messrs. Ashcraft and Nation. Membership, Messrs. Jones and Foss	E. J. Stern presented a technicolor movie on operation of locker plants in Texas	29	0.60
Ontario	Feb. 5	Chimneys, Flues and Drafts for Houses and Smaller Public Buildings	H. R. Shook, National Sewer Pipe Co., Ltd., J. D. Ryder, Toronto, and D. O. Price, General Steel Wares, Ltd., Toronto	Pres. Morgan announced member of Nominating Committee; H. D. Henion, Chm., H. S. Moore, W. R. Blackhall	101	0.48
	Jan. 8	Year Around Air Conditioning for Residences and Smaller Commercial Establishments	John Knighton	V. J. Jenkinson urged members to attend Annual Meeting in Boston	83	0.44

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Oregon	Jan. 4	Prophecy of the Past and Future	W. G. Buback, Oregon State College	Heating codes were discussed Discussion followed report by W. B. Morrison, Chm., Public Relations Committee	16	
Pittsburgh	Feb. 12	The Role of Sterilization in Air Conditioning	Prof. B. H. Jennings, Professor of Mechanical Engrg., Northwestern University	Discussion followed with Prof. Jennings answering many questions	62	0.41
Rocky Mountain	Jan. 17	Radiant Heating	F. W. Hutchinson, University of California	Question and Answer period followed	119	2.33
	Dec. 7	Trans-Mountain Diversion, the Big Thompson Project, and the Blue River-South Platte Project	Mills E. Bunger, Planning Engr., U. S. Bureau of Reclamation	Discussion followed which proved interesting and educational	30	0.50
St. Louis	Jan. 9	Panel Discussion on Radiant Heating Mr. Deverall, Purdue University, summed up with the work being done at Purdue to find some of the answers to problems in radiant heating	Joe Blackmore acted as Chairman of Panel E. Kane, Archt., Edwardsville, Ill., spoke from standpoint of house and building design Mr. Mayer, A. E. Mayer Plbg.-Htg. Co., gave history of heating from contractor's angle	Mr. Simpson of A. M. Byers Co. talked on development of principles for the installation of panel heating Mr. Schwind, Minneapolis-Honeywell Regulator Co., spoke on controlling of a radiant heated house	57	0.85
South Texas	Dec. 15	The Future Industrial Growth in and Around Houston	H. C. Moore, Architect	R. F. Taylor gave report on work and set-up of the proposed Engineers Council Pres. A. F. Barnes announced personnel of Legislative and By-Laws and Rules Committees		
Southern California	Jan. 10	Floating Concrete — Cold Storage Plants	J. N. Berger and H. M. Hendrickson, York Corp.	Mr. Earhart reported on progress of membership committee	62	0.83
Utan	Jan. 15	Radiant Heating	F. W. Hutchinson, University of California, Berkeley, Calif.	Pres. H. G. Richardson presided	45	0.50
Washington, D. C.	Jan. 10	Two films were shown: "The Story of Sylphon Bellows," "Combat America," (first American Air Force in England)	Messrs. Downes, Spurney, Thomas, et al., spoke on the poor ventilation in the YWCA and the need for basic research in fan design	M. F. Hoppe gave his report as Treasurer	103	0.58
Western New York	Jan. 8	Power Plant Engineering and High Pressure Systems	Robert Hill, Riley Stoker Co.	Pres. Sherman Strouse welcomed the members and guests	38	
Wisconsin	Jan. 15	Heat by Radiant Energy	George Coffey, A. M. Byers Co.	Discussion followed Resolution was adopted electing Messrs. H. W. Ellis, C. W. Miller and F. G. Weimer, Life Members of Wisconsin Chapter		

*The attendance ratios shown represent the meeting attendance divided by the Chapter membership. These will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by other local chapters also may be helpful in deciding on subjects for other chapter meetings.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 96 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by March 15, 1945, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
AIKIN, AZIEL A., Plant Engr., Lansing, Mich.	S. H. Downs C. H. Pesterfield	L. G. Miller T. D. Stafford
AITKEN, MILTON L., Gen. Mgr., Propellair, Inc., Springfield, Ohio.	G. L. Tuve C. S. Leopold	G. B. Gerrish S. R. Lewis
ATWATER, H. A., Chief Engr., Combustion Equipment Co., Kansas City, Mo.	R. B. Mason Carl Clegg	W. L. Cassell W. E. Howarth
BLOOM, RALPH L., Mech. Engr., 623 Sexton Bldg., Minneapolis, Minn.	Lyman Gross C. E. Wiser	E. F. Bell W. F. Uhl
BOYARD, CARL A., Sales Engr., Northrup Supply Corp., Utica, N. Y.	J. W. Stevens F. E. Hockensmith	Milner Noble D. D. Wile
BUETER, NORMAN E., Acting Dir. of Sales Comfort Air Cond., Carrier Corp., Syracuse, N. Y.	R. E. Cherne W. G. Hillen	Margaret Ingels V. S. Day
CURTIS, HERBERT D., Co-Partner, Hunter-Prell Co., Battle Creek, Mich.	O. D. Marshall F. C. Warren	A. H. Snook W. G. Schlichting
CARPENTER, JAMES H., Director, Student Training, Carrier Corp., Syracuse, N. Y.	R. E. Cherne W. G. Hillen	Margaret Ingels V. S. Day
CHANG, TING C., Student Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
CHUKWUEMEKA, NWANKWO, Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
CLEMINS, RICHARD J., Student Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
CREARS, TOM H., Mfrs. Repr., 1824 S. Hope St., Los Angeles, Calif.	Homer Addams E. J. Ritchie	E. M. Mittendorff A. J. Hess
CRISMAN, LEON J., Owner, Crisman Heating & Air Conditioning Co., Lansing, Mich.	C. H. Pesterfield L. G. Miller	B. F. McLouth F. C. Warren
CHRISTIE, ROBERT W., Engr., United States Testing Co., Inc., Hoboken, N. J.	*Stuart Walker *B. A. Schroeder	*A. J. Kellner *G. R. Turner
CHURCH, RICHARD A., Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
DARLAIS, GORDON M., Test Engr., Sunbeam Electric & Manufacturing Co., Evansville, Ind.	W. A. Rowe R. H. Anderegg	William Goodman *Hayden Oldham
DAWSON, RUSSELL F., Dist. Mgr., Bastian Morley Co., Inc., Atlanta, Ga.	M. F. DuChateau J. A. Como	B. J. Seckinger, Jr. C. B. Cole
DYER, DONALD E., Mech. Engr., Carrier Corp., Syracuse, N. Y.	R. E. Cherne W. G. Hillen	Margaret Ingels V. S. Day
DAVAGE, THOM D., Htg. & Vent. Engr., Cleveland Graphite Bronze Co., Cleveland, Ohio.	J. P. Jones R. L. Byers	D. L. Taze R. F. Stamberger
EARKY, ALY, Dir. of Works, Mech. & Elec. Dept., P.W.M., Cairo, Egypt.	M. E. Tahry K. Ezz-El-Din	M. V. Brakha *A. E. Fayed
ENNER, WALTER M., Engr. & Secy.-Treas., Central Mill & Plumbing Supply Corp., Columbus, Ohio.	R. B. Jackson C. H. Wolfe	A. W. Williams H. R. Allonier
ETTINGER, EDGAR W., Prod. Design Engr., American Furnace Co., St. Louis, Mo.	B. C. Simons C. E. Hartwein	L. R. Szombathy J. W. Cooper
EZILSAMER, PHILIPPE, Student Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
ANSEN, JOHN S., Testing Engr., Sears Roebuck & Co., Chicago, Ill.	R. C. Cross H. R. Limbacher	H. F. King W. F. Friend
ENSON, LARS C., Asst. Dir. of Development, Carrier Corp., Syracuse, N. Y.	C. M. Ashley D. D. Wile	W. H. Driscoll J. W. Stevens
ERT, WINSTON W., Jr. Engr., Carrier Corp., Syracuse, N. Y.	C. M. Ashley D. D. Wile	W. H. Driscoll W. A. Grant
ACOCK, GROSVENOR W., Sales Engr., O'Brien Specialty Co., Syracuse, N. Y.	J. W. Stevens C. M. Ashley	F. E. Hockensmith Milner Noble
ERMAN, DONALD D., Chief Engr., Hartzell Ind., Inc., Piqua, Ohio.	J. O. Kirkbride H. M. Parent	*R. N. Hartzell *R. I. Blayney
T, DONALD R., Pipe Shop Foreman, R.C.A. Victor Division, Camden, N. J.	L. H. Plum C. G. Binder	*J. H. Glanding *Albert Fisch, Jr.
SAKER, ROY E., Engr., Owens Corning Fiberglas Corp., Toledo, Ohio.	H. E. Lewis T. D. Stafford	Wharton Clay J. W. James
ETT, MERRICK Y., Student Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
NSON, HUGH F., JR., Student Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen
TICE, JACK T., Prop., Jack T. Justice, Paragould, Ark.	R. H. Feltwell P. R. Achenbach	R. S. Dill E. J. Stearns, Jr.
NEDY, JAMES C., Htg. Engr., Edward Joy Co., Syracuse, N. Y.	C. F. Woese J. W. Stevens	*P. D. Robson Milner Noble
E, GERALD C., Acoustical Engr., Taylor Seidenbach, Inc., New Orleans, La. *(Advancement)*	G. E. May J. S. Burke	C. B. Gamble L. V. Cressy
AYENHOF, HAROLD G., Sales Mgr., The Lennox Furnace Co., Inc., Syracuse, N. Y. *(Reinstatement and Advancement)*	F. E. Hockensmith C. M. Ashley	J. W. Stevens Milner Noble
, WING-CHING, Student Engr., Carrier Corp., Syracuse, N. Y.	James Carpenter R. E. Cherne	W. A. Grant W. G. Hillen

*Non-member.

LANKTON, FOREST, Engr., Oldsmobile, Lansing, Mich.

LAWLESS, ALBERT J., Partner, Hubbard, Rickerd & Blakeley, New Haven, Conn.

LAYTON, J. W., Chief Engr., Propellair, Inc., Osborn, Ohio.

LEE, BOYD J., Owner, B. J. Lee Co., Memphis, Tenn.

LETT, MAX A., Mech. Engr., 701 Michigan Trust Bldg., Grand Rapids, Mich.

LEVERIDGE, ROBERT H., Student Engr., Carrier Corp., Syracuse, N. Y.

LYNCH, C. B., Chief Engr., McCann Furnace Co., Cleveland, Ohio.

LYONS, EARL C., Htg. & Air Cond. Engr., General Engineering Co. (Canada), Ltd., Toronto, Ont., Canada.

MAHONEY, C. L., Owner, C. L. Mahoney, Kalamazoo, Mich.

MATTSON, ROGER K., Engr., McQuay, Inc., Minneapolis, Minn.

MCCLINTOCK, WALTER C., Dist. Mgr., Reznor Manufacturing Co., Milan, Tenn.

MCCUMBER, BURTON R., Staff Asst., Carrier Corp., Syracuse, N. Y.

MCGRATH, WILLIAM L., Project Engr., Carrier Corp., Syracuse, N. Y.

MEHLEK, JOHN F., Dist. Sales Mgr., Erie City Iron Works, Cleveland, Ohio.

MILEY, JULIAN J., Supt., Scott Co., San Francisco, Calif.

MOONEY, MARK E., Dir. of Sales Applied Refrig., Carrier Corp., Syracuse, N. Y.

MORAN, EDWARD V., JR., Student Engr., Carrier Corp., Syracuse, N. Y.

NELSON, VERNON E., Mgr., General Heating Products Co., Minneapolis, Minn.

PATRICK, GEORGE P., Student Engr., Carrier Corp., Syracuse, N. Y.

PATTERSON, JAMES C., Dir. of Sales—Ind. Htg., Carrier Corp., Syracuse, N. Y.

PEARY, HOWARD W., Factory Engr., Wrigley Bldg., Chicago, Ill.

PERKINS, STANLEY H., Application Engr., Minneapolis-Honeywell Regulator Co., Syracuse, N. Y.

PHILLIPS, CHARLES R., Factory Planning Engr., Northern Electric Co., Ltd., Montreal, Que., Canada.

PINKERTON, JOHN B., Cons. Engr., Dolby & Williamson, Westminster, London, England.

POPE, EDWARD F., Business Mgr., Carrier Corp., Syracuse, N. Y.

POWELL, LEROY D., Owner, L. D. Powell Construction Co., Memphis, Tenn.

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REICHOW, WILLIAM A., Branch Mgr., Minneapolis-Honeywell Regulator Co., Kansas City, Mo.

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SANDERS, WILLIAM L., Partner, Midwest Plumbing & Heating Co., Kansas City, Mo.

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SMITH, STANLEY K., 1st Vice-Pres., The H. B. Smith Co., Inc., Westfield, Mass.

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TUCKER, SYDNEY, Chief Engr., Fitzgibbons Boiler Co., Inc., Oswego, N. Y.

WALSH, GERALD W., JR., Test Engr., Carrier Corp., Syracuse, N. Y.

WARMING, HURLEY O., Application Engr., Thermal Co., Inc., St. Paul, Minn.

WHITE, ARTHUR A., Managing Dir., Gilbert & Barker Manufacturing Co., Ltd., Toronto, Ont., Canada.

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WHITE, JACK A., Student Engr., Carrier Corp., Syracuse, N. Y.

WILLIAMS, CHARLES R., Vice-Pres., Dickie Construction Co., Ltd., Toronto, Ont., Canada.

WILLIAMS, EDGAR H., Student Engr., Carrier Corp., Syracuse, N. Y.

WILSON, MAURICE J., Engr., Carrier Corp., Syracuse, N. Y.

WOODRUFF, HENRY S., Product Engr., Carrier Corp., Syracuse, N. Y.

WYLIE, WILSON J., Asst. to Mgr., Power Dept., Toronto Hydro Electric System, Toronto, Ont., Canada.

YEAZEL, HAROLD F., Asst. Sales Mgr., The Lennox Furnace Co., Syracuse, N. Y.

YELLEN, CHARLES F., Htg. & Maintenance Engr., Pratt & Whitney, East Hartford, Conn.

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		W. H. Evans
James Carpenter	R. E. Cherne	W. A. Grant
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		A. J. Strain
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		Milner Noble
E. J. Ritchie	E. R. Clement, Sr.	L. W. Hoyt
		E. C. Marsden

Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

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ANDERSON, WILLIAM S., JR., Partner, Axeman-Anderson Associates, Williamsport, Pa.

BOGEN, ARTHUR D., Gen. Mgr., The Home Furnace Co., Columbus, Ohio.

CHOATE, JAMES E., Branch Mgr., Mundet Cork Corp., Atlanta, Ga.

FAVRET, LOUIS E., Pres., Williamson-Favret Furnace Co., Columbus, Ohio.

HAYS, HERBERT G., Chief Engr., Armstrong Furnace Co., Columbus, Ohio.

HODGKINSON, WILLIAM S., Engr., Ilg Electric Ventilating Co., Boston, Mass.

LOFTE, JOHN A., Engr., Swisher-Hessler Co., Milwaukee, Wis. *(Advancement)*

LUSK, HARRY E., Mgr., DeWitt C. Griffin & Associates, Seattle, Wash.

NORLAND, C. O., Pres., Munkel Heating Co., Columbus, Ohio.

WERNER, CHARLES V., Sales Engr., H. H. Wright Co., Kansas City, Mo.

ASSOCIATES

BENSON, JOHN C., Branch Mgr., Carrier Corp., Washington, D. C. *(Reinstatement)*

CARLEY, THOMAS S., Sales Engr., Minneapolis-Honeywell Regulator Co., San Francisco, Calif.

FARNUM, WARREN S., Air Cond. & Indus. Refrig. Applica. Engr., Westinghouse Electric Elevator Co., Boston, Mass.

HOLTON, WILLIAM J., Sales & Service, Reeves Wiedeman Supply Co., Kansas City, Mo.

JUNIORS

DETWEILER, JOHN R., Dist. Repr., Minneapolis-Honeywell Regulator Co., Louisville, Ky.

FLEISHER, WALTER L., JR., Mgr., Air & Refrigeration Corp., Atlanta, Ga.

KURTH, FRANZ B., JR., Anemostat Corp. of America, New York, N. Y.

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Connecticut	L. E. Seeley	J. B. [illegible]right
Delta	G. C. Kerr	L. K. [illegible]elson
Golden Gate	C. L. Peterson	R. B. [illegible]olland
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Indiana	G. B. Supple	C. W. [illegible]tewart
Iowa	M. L. Todd	T. R. [illegible]ohnson
Kansas City	R. B. Mason	D. M. [illegible]Allen
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Minnesota	E. F. Bell	J. E. [illegible]ines
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Nebraska	Verne Simmonds	D. E. M[illegible]ulley
New York	C. S. Koehler	H. J. Ryan
North Carolina	F. E. P. Klages	E. S. [illegible]eiss
North Texas	B. J. Foss	R. K. [illegible]erner
Northern Ohio	John James	D. L. Taze
Oklahoma	F. X. Loeffler	E. T. P. Ellingson
Ontario	V. J. Jenkinson	J. P. Fitz[illegible]mons
Oregon	J. A. Freeman	E. C. Willey
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Philadelphia	H. B. Hedges	Edwin Elliot
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Rocky Mountain	F. L. Adams	Elmo Hall
St. Louis	C. F. Boester	B. L. Evans
South Texas	J. A. Walsh	B. P. Fisher
Southern California	Maron Kennedy	Art Theobald
Utah	E. V. Gritton	J. T. Young, Jr.
Washington, D. C.	J. W. Markert	F. A. Leser
Western Michigan	C. H. Pesterfield	F. C. Warren
Western New York	S. W. Strouse	Roswell Farnham
Wisconsin	M. W. Bishop	Ernest Szekely

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Atlanta: Organized, 1937. Headquarters, Atlanta, Ga. Meets, First Monday. President, I. B. Kagey, 611 Bona Allen Bldg., Atlanta 3. Secretary, M. F. DuChateau, Washington St. Viaduct, Atlanta 3.

Central New York: Organized, 1944. Headquarters, Syracuse, N. Y. President, Milner Noble, 410 S. Geddes St. Secretary, F. E. Hockensmith, 400 N. Midler Ave.

Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. President, J. D. Slemmons, 2 Fifteenth Ave., Columbus 1. Secretary, A. W. Williams, 5 E. Long St., Room 808, Columbus 15.

Cincinnati: Organized, 1932. Headquarters, Cincinnati, O. Meets, Second Tuesday. Honorary President, Capt. C. E. Hust. President, G. V. Sutfin, 1005-6 American Bldg., Cincinnati 2. Secretary, A. W. Edwards, 626 Broadway, Rm. 307, Cincinnati 2.

Connecticut: Organized, 1940. Headquarters, New Haven, Conn. President, L. A. Teasdale, 20 Ashmun St. Secretary, Winfield Roeder, 405 Temple St.

Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, L. V. Cressy, 423 Baronne St., New Orleans 13. Secretary, J. S. Burke, 317 Baronne St., New Orleans 9.

Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Wednesday. President, C. L. Peterson, 2 Indian Rock Path, Berkeley. Secretary, James Gayner, 260 California St., San Francisco 11.

Illinois: Organized, 1906. Headquarters, Chicago, Ill. Meets, Second Monday. President, A. O. May, Room 925, 53 W. Jackson Blvd., Chicago 4. Secretary, C. M. Burnam, Jr., Room 1605, 6 N. Michigan Ave., Chicago 2.

Indiana: Organized, 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. President, W. C. Bevington, 730 Indiana Pythian Bldg. Secretary, C. W. Stewart, 1001 York St.

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Manitoba: Organized, 1935. Headquarters, Winnipeg, Man. Meets, Third Thursday. President, Einar Anderson, 152 Bannerman Ave. Secretary, F. T. Ball, 324 Main St., Calgary, Alta.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, D. M. Archer, 143 Federal St., Boston 10. Secretary, C. W. Larson, 184 Sycamore St., Roslindale.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, J. J. Nolan, 78 Washington Ave., Secretary, W. E. Thorpe, 78 Washington Ave.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, W. H. Old, 1761 Forest Ave. W., Detroit 8. Secretary, A. E. Knibb, 1003 Maryland Ave., Detroit 30.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, F. W. Legler, 17 W. 28th St. Secretary, F. H. Schernbeck, 1057 10th Ave. S. E.

Montreal: Organized, 1936. Headquarters, Montreal, Que. Meets Third Monday. President, A. B. Madden, 1170 Beaver Hall Sq. Secretary, Leo Garneau, Room 832, Dominion Square Bldg.

Nebraska: Organized, 1940. Headquarters, Omaha. Meets, Second Tuesday. President, B. G. Peterson, 6235 Florence Blvd. Secretary, D. E. McCulley, 814 S. 14th St., Omaha 2.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, C. S. Koehler, 4374 Richardson Ave., New York 66. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, F. E. P. Klages, 1034 Jefferson Standard Bldg., Greensboro. Secretary, W. L. Hunken, 707 Guilford Bldg., Greensboro.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, E. T. Gessel, 610 Thomas Bldg., Dallas 1. Secretary, C. Rollins Gardner, 911 Camp St., Dallas 2.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, O. Meets, Second Monday. President, D. L. Taze, 1302 Swetland Bldg., Cleveland 15. Secretary, R. H. Cutting, 3795 Glenwood Rd., Cleveland Heights.

Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, E. T. P. Ellingson, 314 Savings Bldg., Oklahoma City 2. Secretary, G. T. Donceel, Oklahoma Natural Gas Co.

Ontario: Organized, 1922. Headquarters, Toronto, Ont. Meets, First Monday. President, A. S. Morgan, 156 Glenmanor Dr. Secretary, H. R. Roth, 57 Bloor St., W.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, E. C. Willey, Oregon State College, Corvallis. Secretary, G. H. Risley, 516 S. W. Oak St., Portland 4.

Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, M. N. Musgrave, 2019 Third Ave., Seattle 1. Secretary, J. D. Sparks, 7331 W. Green Lake Way, Seattle 3.

Philadelphia: Organized, 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, A. C. Caldwell, 550 So. 48th St., Philadelphia 43. Secretary, J. O. Kirkbride, Fourth and Locust Sts., Philadelphia 6.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, T. F. Rockwell, Carnegie Institute of Technology, Schenley Park. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, J. H. McCabe, 1730 Glenarm St. Secretary, F. L. Adams, P. O. Box 840, Denver 1.

St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, G. B. Rodenheiser, 4431 Finney Ave., St. Louis 13. Secretary, B. L. Evans, 571 Stratford Ave., University City.

South Texas: Organized, 1938. Headquarters, Houston, Texas. Meets, Third Friday. President, A. F. Barnes, 602 Kirby Bldg., Houston 2. Secretary, B. P. Fisher, Box 92, Houston 1.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Second Wednesday. President, Leo Hungerford, 3485 Wonderview Pl., Los Angeles 28. Secretary, Arthur Theobald, 336 North Foothill Rd., Beverly Hills, Calif.

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. President, H. G. Richardson, 1433 Harvard Ave. Secretary, E. V. Gritton, 2470 So. 15th East St.

Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, J. W. Markert, 8506 Garfield St., Bethesda, Md. Secretary, A. S. Gates, Jr., 111 County Rd., Kensington, Md.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, H. D. Bratt, 2259 Stafford Ave., S. W., Grand Rapids 7. Secretary, Frank Harbin, Jr., 181 West 21st St., Holland.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, S. W. Strouse, 493 Franklin St., Buffalo 2. Secretary, G. E. Adema, 39 W. Balcom St.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, I. J. Haus, 3880 N. Richards St., Milwaukee 1. Secretary, M. W. Bishop, 361 W. Wisconsin Ave., Milwaukee 3.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1945 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Method of Detecting Methyl Chloride in "Freon-12"

No. 2775—Because of the great use of "Freon-12" by the armed forces of the Allied Nations both for refrigeration and in aerosol for malarial mosquito control, it is necessary for the War Production Board to regulate the end use of "Freon-12." As a consequence, a considerable number of refrigerating machinery installations have been converted temporarily from "Freon-12" to methyl chloride, and it is assumed that they will be reconverted in the postwar period. A. C. Buensod, of Buensod-Stacey, Inc., has been doing a lot of postwar thinking and posed the problem of finding a method of determining quickly what refrigerant is in an installation and if there has been a mixture of methyl chloride with "Freon-12."

The research laboratory of Kinetic Chemicals, Inc., 10th and Market St., Wilmington 98, Del., has found the answer, according to R. J. Thompson, refrigeration engineer. Methyl chloride may be hydrolyzed with piperidine in a wet methanol solution and the freed hydrochloric acid detected by the formation of a silver chloride cloud upon the addition of a silver nitrate solution. "Freon-12" is a stable refrigerant and is not hydrolyzed by piperidine under the test conditions. With this method as small an amount of methyl chloride as 0.5 per cent by weight can be detected in the "Freon-12." Less than 2 g of refrigerant is required for the test.

It is the hope of Kinetic Chemicals, Inc., that those who supply the service man will be interested in making the small kits for his use. They will not be expensive. No patent applications have been made by Kinetic and no royalties are involved. As an organization devoted to serving the refrigerating machinery industry, Kinetic gives the idea to the trade, but assumes no responsibility connected with its use. Kinetic does not supply these kits.

The kits can be made up by a laboratory or pharmacy according to the formula:

Solution A (volume 7.4 ml):
- 1.0 gram (1.1 ml) piperidine
- 5.0 grams (6.3 ml) methyl alcohol, C.P.
- 0.1 gram (0.1 ml) distilled water

In clean 6 dram glass vial rinsed with methyl alcohol, lead lined bakelite screw cap.

Solution B (volume 11.3 ml):
- 0.1 gram silver nitrate, C.P.
- 2.0 grams (1.4 ml) nitric acid, C.P., d 1.42
- 10.0 grams (10.0 ml) distilled water

In clean 4 dram glass vial rinsed with distilled water, oil paper lined bakelite screw cap.

Four inch length of clean 7 mm (or 8 mm) glass tubing, fire polished at ends, rinsed with methyl alcohol.

Four inch length of clean ¼ in. rubber or synthetic rubber tubing, rinsed with methyl alcohol.

Methyl alcohol, distilled water, silver nitrate, nitric acid, vials and caps, and glass and rubber tubing are carried in stock by most scientific supply houses. Piperidine may be ordered through any scientific company. It is advisable to use fresh piperidine of the best quality available. However, a yellow coloration is not harmful. It will be convenient to make up some multiple of formula A in a clean glass stoppered bottle and accurately measure 7.4 ml of this solution into each 6 dram vial. Likewise, a multiple of formula B may be made up in a clean glass stoppered bottle and a 11.3 ml portion of this solution added to each 4 dram vial. One kit from each lot should be checked by mixing the two solutions and stirring with the glass tube. The mixture must be perfectly clear.

Directions for Detecting Methyl Chloride in "Freon-12"

Provide a valved outlet and ¼ in. copper tubing from the vapor phase of the "Freon-12" system to be tested.

Open the valve slightly and clear the valve and the short length of copper tubing of liquid refrigerant and oil; then close valve tight.

Connect glass tube to the copper tube with the rubber tubing.

Support the larger vial (solution A) containing the piperidine in an upright position. Insert end of glass tube into the large vial so that the end of the glass tube is ¼ in. above bottom of the vial.

Carefully open refrigerant vapor valve until three bubbles per second are obtained.

Bubble refrigerant vapor through solution in large vial for 15 min.

Then add contents of smaller vial (solution B) containing silver nitrate slowly and carefully to the larger vial. Any turbidity, milkiness, cloudiness, or opalescence of the liquid means that this sample of "Freon-12" has been contaminated with methyl chloride or some other adulterant.

Only new or thoroughly cleaned and dried vials should be used as vials cleaned and wet with chlorine treated water may give false results. Use new solutions for each test.

Vapor valve to control refrigerant vapor bubbles must be opened slowly and care should be exercised to protect clothing and skin from the solutions. Also, large lens spectacles or goggles should be worn to pre-

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Heating, Piping & Air Conditioning, [3-45]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(*Circle each number in which you are interested*)

2775	2776	2777	2778	2779	2780	2781	2782	2783
2784	2785	2786						
4893	4894	....	4896	4897	4898	4899	4900	4901
4902	4903	4904	4905	4906	4907	4908	4909	4910
4911	4912	4913	4914	4915	4916	4917	4918	4919
4920	4921	4922						

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

A BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.
- **SECOND**—*Finish*. Cadmium plated inside and out for protection against corrosion.
- **THIRD**—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.
- **THOUSANDS IN SERVICE**—Sold by over 100 Mill Supply Houses.

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-200.

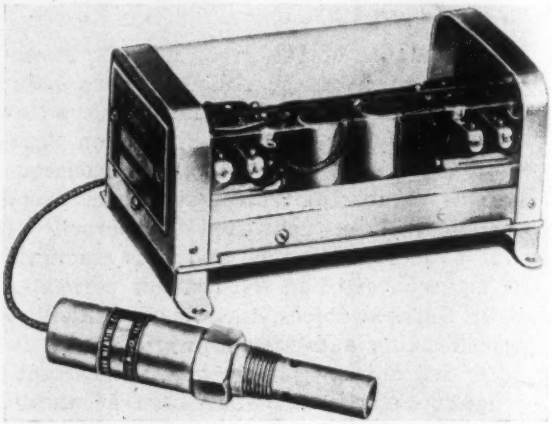
YARNALL-WARING COMPANY
107 MERMAID AVENUE • PHILADELPHIA 18, PA.

YARWAY STRAINERS

vent damage to the eyes. Silver nitrate and nitric acid are corrosive chemicals and may cause injury to the skin, eyes, and clothing.

Temperature Regulating Unit

No. 2776—The "Modutemp" is a temperature regulating unit for heating and ventilating systems using motorized dampers for control. It employs the principle of a temperature gap formed by two electrical contacts in a mercury thermostat which control individual relays. The contacts are set to meet the temperature specifications and range of the individual requirements.



When the mercury falls below the temperature gap, the damper motor runs toward the heat position and both relays apply electric heat to the thermostat to assist the mercury to rise again into the gap. When the mercury enters the gap, the motor operation stops and the heat from No. 1 relay cuts off, slowing down the rise of the mercury. The damper holds this static position until the mercury moves out of the temperature gap between the two contacts. If the mercury rises above the gap, the damper motor operates toward the cool position and No. 2 relay cuts off the remaining heat on the thermostat tending to make the mercury fall and reenter the gap, stopping the damper movement.

The system may be specified to handle various sizes of motors. Where hydraulic or pneumatic power is used, the unit controls through operation of solenoid valves. The damper positions at any point necessary to satisfy the thermostat and is not limited to steps or a set number of degrees of movement, says the manufacturer, the Vapor Car Heating Co., Inc., 80 E. Jackson Blvd., Chicago.

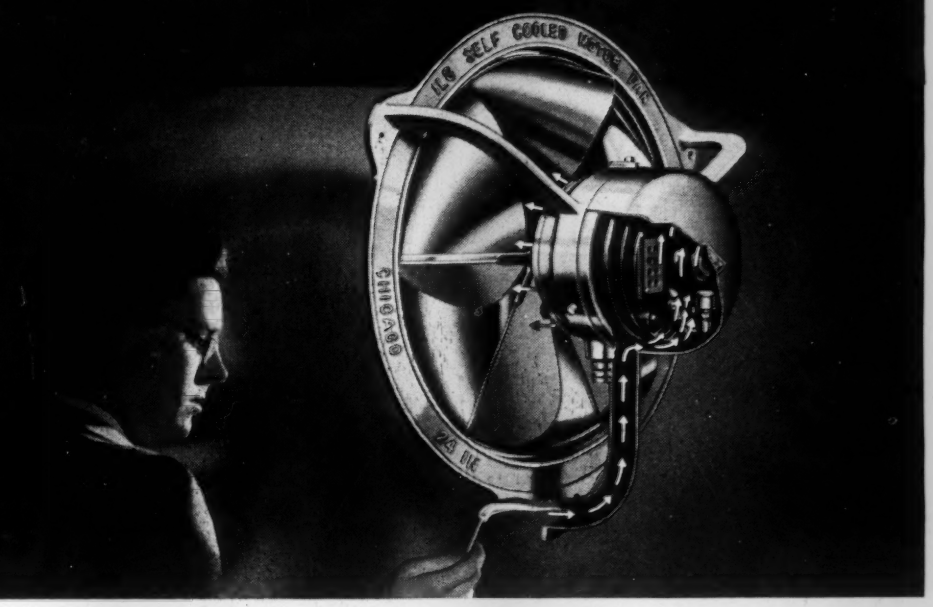
Buys Stoker Patents and Trademarks

No. 2777—The Airtemp Div. of Chrysler Corp. has purchased certain assets of the Stokol Div. of the Schwitzer-Cummins Co. at Indianapolis, and will use its machinery, tools, and inventory for the production of stokers and other equipment.

The announcement was made by D. W. Russell, president of Airtemp, following negotiations which included acquirement of all Stokol patents and trademarks, and a two year lease on the Stokol plant.

The new company has been named Stokol Stoker Co., Inc., and will operate independently of Airtemp.

WHY ARE ILG MOTORS "SELF-COOLED"?



To operate at peak efficiency in the polluted air stream of an exhaust fan!

Open-type motors for ventilating duty have windings exposed to dust, grease and foreign matter in air stream—soon "gum-up," lose efficiency, require more power, overheat. *Fully enclosed type* motors must be larger to avoid overheating, consume more current, block out greater portion of fan area—deposits form a blanket of insulation causing motor to "run hot."

Recognizing these difficulties, ILG designed and built its own motor with patented self-cooling feature to operate at peak efficiency with an exhaust fan. Since it is *an open-type motor*, you reap the benefits of smaller size, lower operating costs (saves 5 to 10%!). *Removable metal hood* over motor prevents foreign matter from depositing on windings to interrupt service. *Vent pipe* brings in fresh, cool, *outside* air to circulate through motor. Motor stays clean, cools itself, operates efficiently for years with a minimum of attention.

For more details on this exclusive ILG feature and free copy of 88-page ILG-BOOK, phone nearby Branch Office (consult classified directory) or write us today.

ILG

VITALIZED VENTILATION

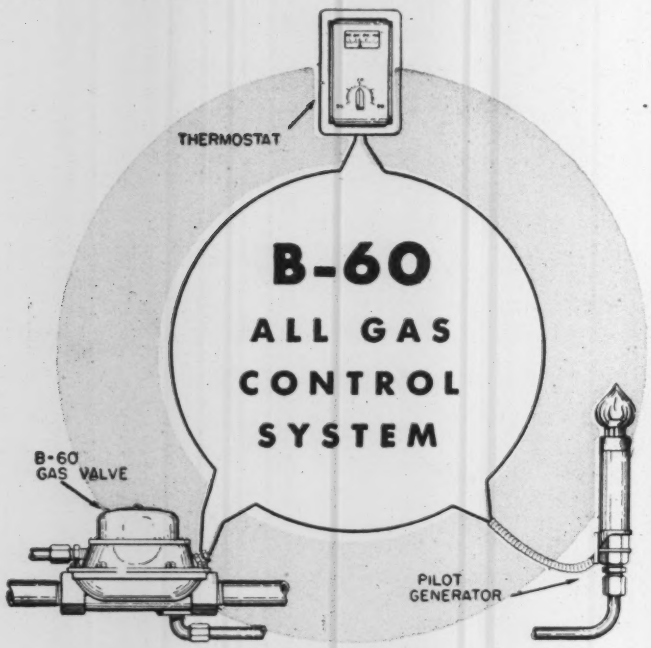
AND AIR CONDITIONING

FREE!
88-page book on solutions to ventilating problems.

WANTED: GRADUATE ENGINEERS!
for ILG Branch Offices, also Research and Engineering Departments. Exceptional opportunities now and post-war for graduates of accredited technical schools. Send details on education, experience, health, age, marital status, etc.

ILG ELECTRIC VENTILATING CO., 2841 N. Crawford Avenue, Chicago 41, Ill., Offices in 38 Principal Cities

GENERAL CONTROLS



A completely self-contained and self-operating system, consisting of a T-80 Series Trimtherm Thermostat, a B-60 Gas Valve and a Pilot Generator. No outside current is needed.

PILOT GENERATOR—This ingenious device is an exclusive General Controls development. Designed on the thermocouple principle, the Pilot Generator supplies all necessary current for operation of the B-60 Gas Valve.

T-80 TRIMTHERM—Trimtherm's modern, streamlined appearance and advanced engineering design, make it a universal choice for accurate, remote control of room temperature.

B-60 GAS VALVE—Compact. Tamper-proof cover. Integral pilot valve assembly. Extremely strong valve body. Increased seating pressure, maximum capacities. Locked binding posts prevent turning.

For further information, contact your nearest General Controls factory branch or distributor, or write for Catalog 52-B.

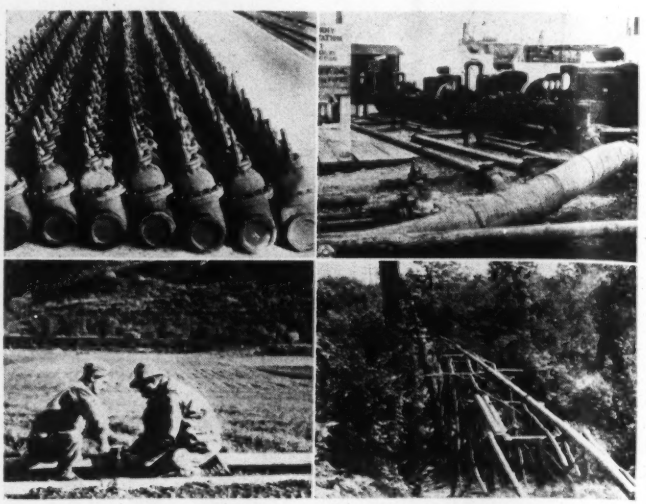
GENERAL CONTROLS
801 ALLEN AVENUE GLENDALE 1, CALIF.

BRANCHES: ATLANTA • BOSTON • CHICAGO • KANSAS CITY • DALLAS • DENVER • DETROIT • HOUSTON
PHILADELPHIA • NEW YORK • CLEVELAND • SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES

The "Pipe Line Express"

No. 2778—You've heard of the Red Ball Express and the White Ball Express operating on the Western front, but have you heard about the "Pipe Line Express"?, asks the Crane Co., 836 S. Michigan Ave., Chicago 5.

With roads under fire, bombed-out bridges, and rough terrain to cross, getting vital gasoline and oil to the flying fields and mechanized units was a job for unsung heroes. Pipe lines were the only way out and 90 per cent of all the gasoline reaching the front is piped there through lightweight lines.



With special wartime materials and Army crews trained in Louisiana, 30 to 40 miles of pipe lines were slapped together every day by using pipe of thin steel plate, half the normal weight. Each pipe end was machined for use with demountable couplings and specially constructed gaskets, permitting the joining of sections of pipe with a few turns of a wrench.

The accessory pipe line equipment, including storage tanks and pumps as well as pipe, was redesigned and lightened so it could be moved quickly and easily in most any lightweight vehicle that might be at hand. The lines were laid above ground.

Plans for the system were worked out by Army engineers, oil experts, Crane Co., and other valve and fitting manufacturers coordinating valves, pipe, pipe connectors, and pumps into one readily assembled unit.

Cast Irons Containing Chromium

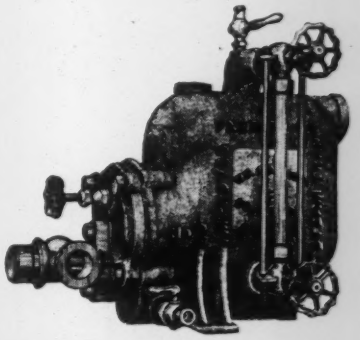
No. 2779—The skill that gray iron foundrymen have acquired in the control of their products points to the possibility that, for temperatures up to 1400 F, cast irons containing chromium up to 2 per cent may become more common, when this chromium maximum is combined with other alloying elements to maintain high strength gray iron structures with a high resistance to thermal shock, J. S. Vanick of International Nickel Co.'s research and development division told a recent meeting of the Pittsburgh Foundrymen's Association.

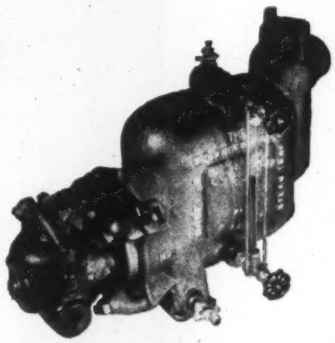
Many common applications of furnace parts, grate bars, coke oven castings, etc., may be eligible for improvement with this type of material, Mr. Vanick stated. These castings will sacrifice machinability, however, since the gray iron structure will be comparatively hard, he added.

Through 3 WARS *with*
ANDERSON STEAM TRAPS

1898-1902

Back in 1898, when the Spanish-American War and the Philippine Insurrection were taking place, The V. D. Anderson Company was manufacturing and selling the Model "N" Steam Trap, shown at the right, as the most dependable means of draining condensate from steam lines.





1917-1918

When the boys sailed for Europe in 1917, to fight in World War I, an improved Float Trap, Model "D," was serving steam trap users. This trap is still giving dependable service on many steam lines.

1941-194X

As we enter the fourth year of this war, the popular Anderson Super-Silvertop Inverted Bucket Steam Traps are draining condensate in thousands of industrial concerns making war supplies.

Today's Super-Silvertop Steam Traps lead in efficiency and economy, but even today's Super-Silvertop may be superceded by a better trap in years to come. One thing you can depend upon—Anderson Engineers, with over a half century of steam trap experience, will continue to provide steam trap users with the most efficient and economical means of draining condensate.

THE V. D. ANDERSON COMPANY
1949 WEST 96th STREET • CLEVELAND 2, OHIO

Super-Silvertop
—STEAM TRAPS—

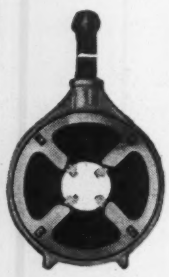
Workholder sets to pipe size instantly
Dies set to pipe size in 10 seconds
65-R
THE RIDGE TOOL CO. ELYRIA, OHIO, U.S.A.
CLOSE DIES

PERFECT THREADS

with surprising ease and speed

with this self-contained RIDGID No. 65R

• No wonder the popularity of this threader has spread widely. The speed and ease with which it cuts clean perfect threads on 1" to 2" pipe are reasons enough. One set of high speed steel chasers threads all 4 sizes — and they set to pipe size in 10 seconds! Workholder sets instantly! You'll like other work-saver features of this rugged steel-and-malleable die stock — it pays you to try the self-contained No. 65R at your Supply House.



No. 65R stands up handily when you want it to.

RIDGID

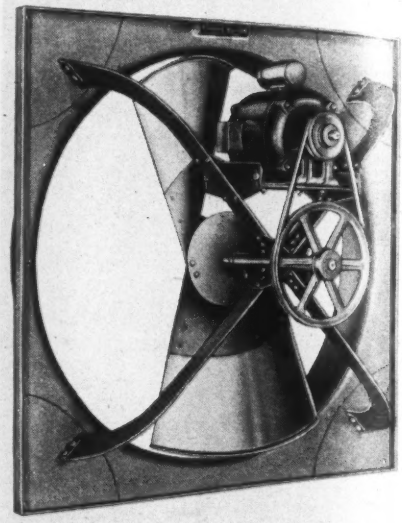
WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY · ELYRIA, OHIO, U. S. A.

New Propeller Fans

No. 2780—Development of a new and improved line of propeller fans for industrial, commercial, and public applications has been announced by the Herman Nelson Corp., 1824 Third Ave., Moline, Ill. They are available with either direct or belt drive and in a wide range of sizes and air deliveries.

According to the manufacturer, the most important feature is the "airfoil" profile with the pitch increasing toward the hub. This airfoil section, it is claimed, not only increases efficiency and permits quieter operation but minimizes undesirable overloading tendencies. The peripheral edge of the blade is flanged backwardly to reduce air turbulence. Fan blades are fabricated of aluminum and formed by hydraulic pressure.

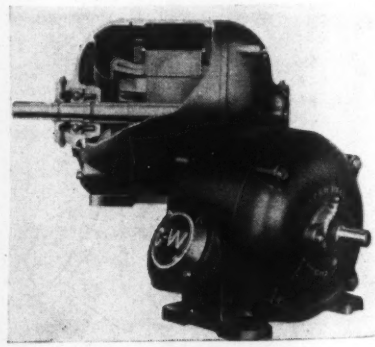


Each fan through the 36-in. size has only two blades while the larger three sizes have three blades. The minimum number of blades required has been used "to keep any sound caused by the fan at the lowest possible pitch."

Protected Type Motor

No. 2781—A new motor, "combining the surplus capacity of the conventional open motor with protection against dripping liquid, falling metal chips, and other foreign matter," has been developed by the Crocker-Wheeler Div. of Joshua Hendy Iron Works, Ampere 1, N. J.

Rated 40 C rise, full-load continuous duty, with a 15 per cent service factor, these motors are available in sizes up to and including the 284 frame. Mounting dimensions conform to the standards of the NEMA.



There are no openings in the frame or shields above the horizontal center line. This, together with the shielded construction of the ventilating openings, makes these motors suitable for machine tool and similar applications.

Centrifugal seals permit use of softer grease for better lubrication and longer bearing life. The "Alucast" rotor construction, in which the bars, fans, and end rings are cast in one operation from aluminum alloys, is employed.

What makes it so good?

Let's take a Badger Packless Self-equalizing Corrugated Expansion Joint "apart" to see what makes it "tick":

BADGER ALL-CURVE CORRUGATION DESIGN gives the corrugations of these joints a durability under flexing that is unsurpassed in any other design. . . . Flexing stresses naturally spread more evenly over the contour of such corrugations than over straight-side corrugations which encourage stresses to localize.

BADGER ALL-CURVE EQUALIZING RINGS (exclusive in Badger Joints) provide DIRECTED FLEXING. These rings further assure uniform distribution of stresses—not only throughout each corrugation, but also among *all* the corrugations in the joint.

BADGER PACKLESS CONSTRUCTION. Forming of the joint proper from a single piece of tubing eliminates the need of packing. This saves the expense of packing maintenance—and, consequently, of manhole and tunnel construction in underground installations.

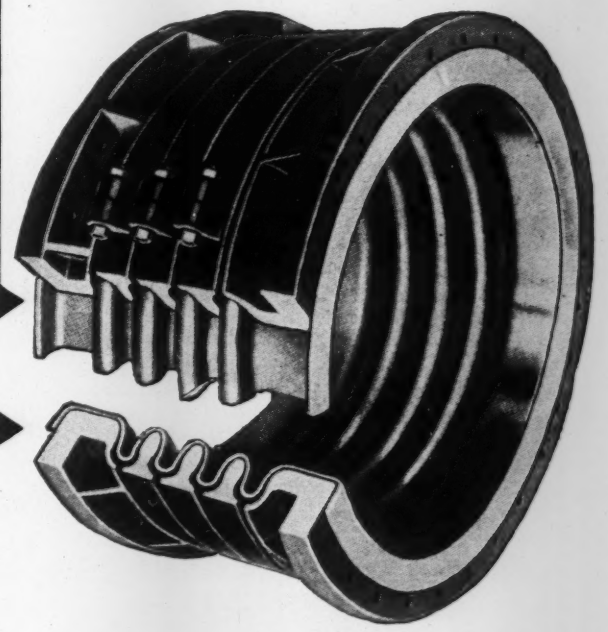
BADGER SPECIAL HEAT-TREATMENT of joints after forming preserves their flexing qualities — and is an added factor in making these joints efficient, dependable and long-lived.

BADGER PACKLESS SELF-EQUALIZING CORRUGATED EXPANSION JOINTS are made in Copper for normal pressures and temperatures; in Stainless Steel for higher requirements—and where corrosion is a problem. Single and multiple corrugations—to take care of traverses ranging from a fraction of an inch upward. Also made in Non-equalizing type for pressures and traverses that do not require the added protection of equalizing rings.

FREE BULLETINS: *No. 100 on Self-equalizing. No. 200 on Non-equalizing.*

E. B. BADGER & SONS CO., 75 Pitts Street, Boston 14, Mass.
AGENTS IN PRINCIPAL CITIES

IF IT'S **BADGER**-MADE, IT'S **GOT SOMETHING!**



Badger PACKLESS CORRUGATED EXPANSION JOINTS

PETRO
REG. U.S. PAT. OFF

OIL BURNING SYSTEMS

Petro Class A (Industrial) Equipment is currently available under W.P.B. regulations and ratings.

Petro equipment includes:

DOMESTIC "CONVERSION" BURNERS
1 to 6 gal. per hour

LARGER "LIGHT (No. 3) OIL" BURNERS
general application type
6 to 18 gal. oil per hour

COMBINATION BURNER-GENERATOR UNITS
both steel and C. I. sectional boilers; forced warm air units; and instantaneous water heaters.

INDUSTRIAL OIL BURNERS
Manual - Semi Auto - and Automatic* for either un-heated or pre-heated industrial oils, up to 145 g.p.h. Built-in motor or belt drive.

**When pre-heated oils are burned the Petro Thermal Viscosity system insures consistent maximum combustion efficiency at all firing stages, automatically and reliably.*

Petro Engineering co-operation is still available. Research-development is active. When your post-war activities start, Petro will be ready for you.

OIL IS AMMUNITION
USE IT WISELY

Full data on Petro Industrial Burners are in our Catalog—see Sweet's or Domestic Engineering Catalog Files — or we will gladly send copies on request.

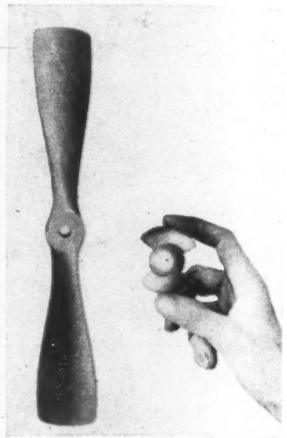
PETROLEUM HEAT AND POWER COMPANY

Makers of Good Oil Burning Equipment Since 1903

STAMFORD CONNECTICUT

Two Inch and Sixty Inch Fans

No. 2782—Two new high efficiency axial flow fan units have been announced by Dynamic Air Engineering, Inc., 1619 S. Alameda, Los Angeles 21. From "the mighty 60 in. to the midget 2 in., they are believed to be the largest low pressure and smallest high pressure propellers engineered and produced on the Pacific coast," the manufacturer says.

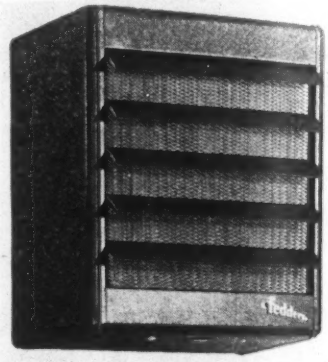


The 60 in. low pressure propeller driven with a 10 hp, 1150 rpm motor, delivers approximately 60,000 cfm free air and 5000 cfm at ½ in. SP, the maker reports.

The 2 in. propeller has been developed for a complete fan unit to be manufactured and marketed by Dynamic. It will be powered by a tiny motor of approximately two-thousandth horsepower, and will deliver 30 cfm at 0.30 in. SP. Originally engineered for the cooling of modulators in airborne electronic equipment, it is expected to find many and varied applications.

New Line of Unit Heaters

No. 2783—A line of "Series 15" unit heaters with streamlined copper tubes and fins has been announced by the industrial heating division of the Fedders Mfg. Co., Inc., 81 Tonawanda St., Buffalo 7, N. Y. A feature is the design of the deep brazing flanges which are extruded into the headers. They provide unusually abundant area of contact between tubes and headers, says the manufacturer.



The line is built in 10 sizes ranging from 100 to 1000 EDR capacity.

Baseboard Heating

No. 2784*—In the room of tomorrow, the radiator will be conspicuous by its absence, says Warren Webster & Co., 17th & Federal Sts., Camden, N. J. At least it won't be seen—and it won't be hiding behind anything so obvious as a panel or an outlet grille. The radiator "is now reduced to something so small that it fits behind the baseboard—and goes all around the exposed walls of the room, delivering even heat to every corner."

The heating unit is a pipe around which are coiled fins of fine copper sheet. Air comes in at the floor line, passes over the heating unit, and warmed air comes out at the top. In tests of this system, the differential at various levels and sections of the heated area is said to be less than 2 F. The system will be made available when war conditions permit.

Long ago, Icarus proved that you can't fly in the face of Nature

. . . and that's why Allen will NOT build a NO-Back-Draft Ventilator

In ancient days, as the mythological tale of Icarus relates, you were likely to fall on your – ah – face – if you, like Icarus, defied the law of gravity. That law has never been repealed. Nature's laws have a way of staying in the books. You always have to pay high if you defy them. We are reminded of it every time we hear that someone has been offering a "no-back-draft" ventilator, and there have been many offered.

For about a quarter century The Allen Corporation has been wrestling with ventilation problems. We have piled up some valuable experience and we have arrived at some positive ideas about ventilation and ventilation products.

Recently specifications have been appearing, calling for ventilators that will not be subject to mechanical down-draft, or back-draft. What this statement means, is that wind blowing on top of the ventilator should not be able to make it back-draft. First of all, practically any ventilator made can be back-drafted if installed with a negative static inside the building. Since nature abhors a vacuum, air rushes in through the ventilator, in the wrong direction, and attempts to satisfy the vacuum inside the building.

The other kind of back-draft is but rarely encountered in industry. It is the type of back-draft caused by installing a ventilator next to a high building, so that the wind, when coming from the proper direction, will swirl over the top of the adjacent building and down on top of the ventilator, causing it to back-draft.

It is not too difficult to build a ventilator to overcome these conditions, but the price in loss of efficiency that must be paid is a high one. We refer to a test report of the U. S. Bureau of Standards, dated as far back as 1921—and the principles have not changed. This report says in conclusion: "The most effective way of obtaining a large volume of air exhaust is by making use of the region of low pressure produced at the back of a properly designed obstacle. It is best not to allow the air to enter the ventilator, *for it must then be exhausted and will be exhausted at the expense of the air in the ventilator pipe.*"

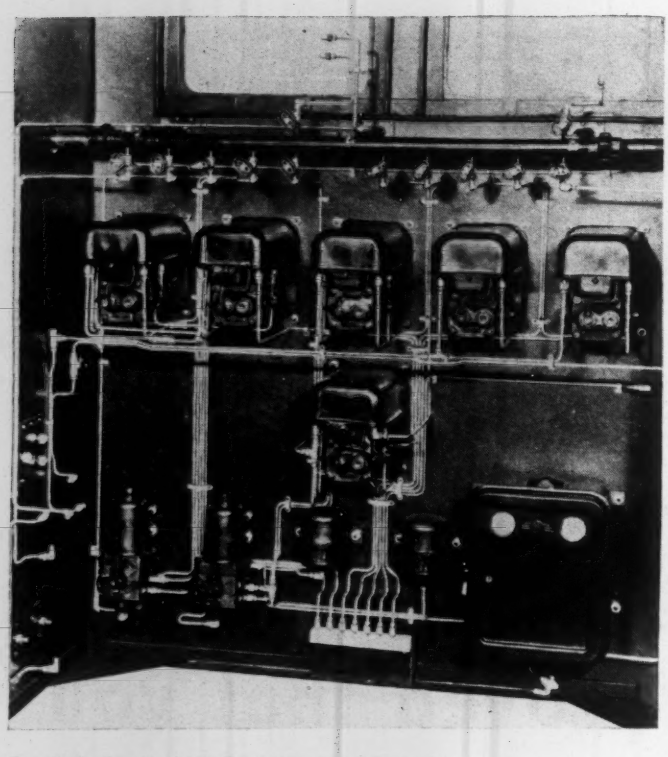
All ventilators which are proof against mechanical back-drafting, rely upon the principle of induction above quoted, and therefore all of them must achieve the no-back-draft feature at the expense of capacity in the main ventilator pipe. That is the reason why Allen will not design a "no-back-draft" ventilator.

We consider the point of "no-back-draft" greatly over emphasized, and feel that a little horse-sense in designing the application of the ventilator will overcome the difficulty on those comparatively few occasions where back-draft conditions are encountered.

And so, you can feel assured that your ventilation problem will get our immediate and careful attention and we will tell you honestly whether you can most economically use gravity or power equipment or a combination of the two. *The Allen Corporation, 9751 Erwin Avenue, Detroit 13, Michigan.*

THE *Allen* CORPORATION

ENGINEERED VENTILATION FOR INDUSTRY



Prefabricated Boiler Control Panel

No. 2785—Prefabricated boiler control panels which include all necessary connecting piping and electrical wiring for the operation of metering equipment and boiler control systems are now offered by Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, to simplify the problem of installation. These panels, which are factory fabricated and tested by experienced instrument mechanics, are said to save installation time, to insure the use of suitable materials, to reduce total installed cost, and to present a neat, pleasing appearance. All piping and wiring necessary for operation is installed as a unit according to a coordinated and prearranged plan.

Small units such as valves, relays, switches, signal lights, and the more sturdy and lightweight instruments are mounted and connected ready for service. Heavy instruments or instruments having delicate mechanisms are shipped separately; but cut out spaces, drilling, and all necessary connections are provided.

Electrode for Heavy Weldments

No. 2786—A new heavily covered arc welding electrode (Type W-27) for flat and horizontal fillet welding as well as for flat butt welding has been announced by the electric welding division of the General Electric Co., 1 River Rd., Schenectady 5, N. Y. Desirable wherever weld requirements include high mechanical properties, rigid x ray examination, good profile, high deposition rate, and good surface appearance, the applications of this electrode include pressure vessels and pertinent connections, heavy machine bases, and structural parts such as column plates, columns, roof trusses, beams, and girders where the thickness of the section permits, says the manufacturer.

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THOSE underworld saboteurs, RUST and CORROSION, are back . . . nibbling away at your iron and steel products. If you are wise, you'll beat these criminals to the draw . . . by using PENNizing, the nemesis of rust and corrosion. The PENNizing process of Quality Hot Dip Galvanizing is the ONLY sure way to guarantee long-lasting protection at an economical cost. Stop . . . look . . . let PENN show you the way!

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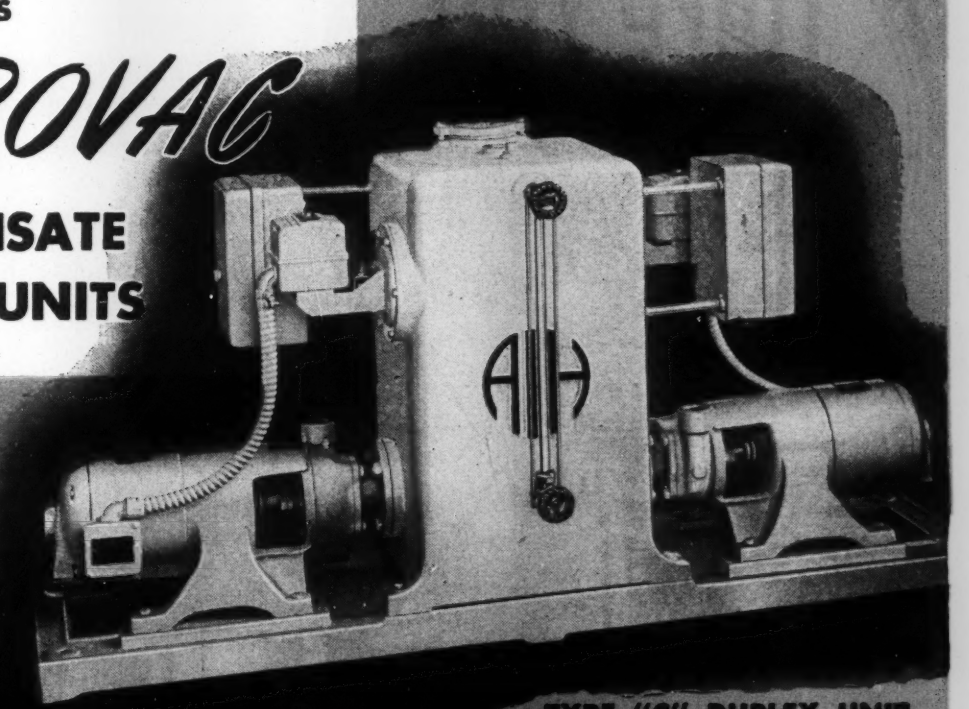
CONDENSATE RETURN UNITS



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TYPE "C" DUPLEX UNIT

SUPERIOR BY GUARANTEE!

The 3-year Wear-Proof Guarantee that goes with Ames HYDROVAC UNITS is an extraordinary document. Back of it is the outstanding character of the metals and materials employed in the design and fabrication of this equipment. Plus the many special features built into Ames HYDROVAC Units.

- NEOPRENE WATER SLINGER
- MOTOR VENTILATION PAT. APPLIED FOR
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- LARGE PACKING SPACE
- HYDRAULIC BALANCE REDUCES THRUST

SUPERIOR ON ALL COUNTS

1. High Efficiency
2. Beauty of Design
3. Lifelong Durability
4. Negligible Maintenance Cost

Ask for Bulletin No. 100-A on complete line of HYDROVAC VACUUM RETURN UNITS

Write for Bulletin No. 200-A Showing Consultants' Specification Form, Standard Ratings and Blueprint

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GUARANTEE CERTIFICATE
This certifies our vacuum return units and our condensate return units are of the finest quality materials and workmanship. With reasonable care in operation the waterproof design of the equipment enables and causes us to guarantee to replace, F.O.B. our works for a period of -3- years from date of shipment, any part, or parts, becoming defective or insufficiently severe to insure the proper operation of the unit.
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KRAMER
Dependable
HEAT TRANSFER
PRODUCTS
Now Serving Our Armed Forces in Every Theater of War . . . . . .
When Victory is here, our increased production facilities will enable us to give quicker deliveries on the complete line of KRAMER refrigeration and air conditioning equipment.
BUY MORE WAR BONDS TO HASTEN VICTORY
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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 163. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending in your request to Heating, Piping & Air Conditioning.

Acoustical Treatment

No. 4893—4 p. bulletin on "Vercoustic" acoustical treatment, a vermiculite product, with information on mixing and application, and table of coefficients of sound absorption.—B. F. Nelson Mfg. Co., 401 Main St., N. E., Minneapolis 13, Minn.

Air Conditioners

No. 4894—4 p. bulletin (47) of the Producers' Council, on 3 hp packaged air conditioners, and combination summer-winter conditioners.—Airtemp Div. of Chrysler Corp., 1119 Leo St., Dayton 1, Ohio.

Air Conditioning, Heating, and Air Handling Equipment

No. 4895†—199 p. catalog (500) describing the manufacturer's complete line of products and including in addition a section of engineering information about air handling equipment and its application in a variety of industrial systems such as heating, ventilating, industrial air conditioning, drying, dust control, fume exhaust, vacuum cleaning, vapor absorption, etc. Descriptions of construction, sizes, and condensed performance tables are presented, and there are photographs of units, system applications, and sectional drawings. A new psychrometric chart is pasted to the back cover.—B. F. Sturtevant Co., Damon St., Hyde Park, Boston 36, Mass.

Air Diffusers

No. 4896—Catalog on "Kno-Draft" adjustable air diffusers which simplifies their selection and application and includes many sketches, charts, instructive text, dimension prints, and other engineering data. There are separate sections on accessory equipment such as dampers, air equalizing grids, mounting rings, and air sectorizing baffles.—W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y.

Air Operated Tools

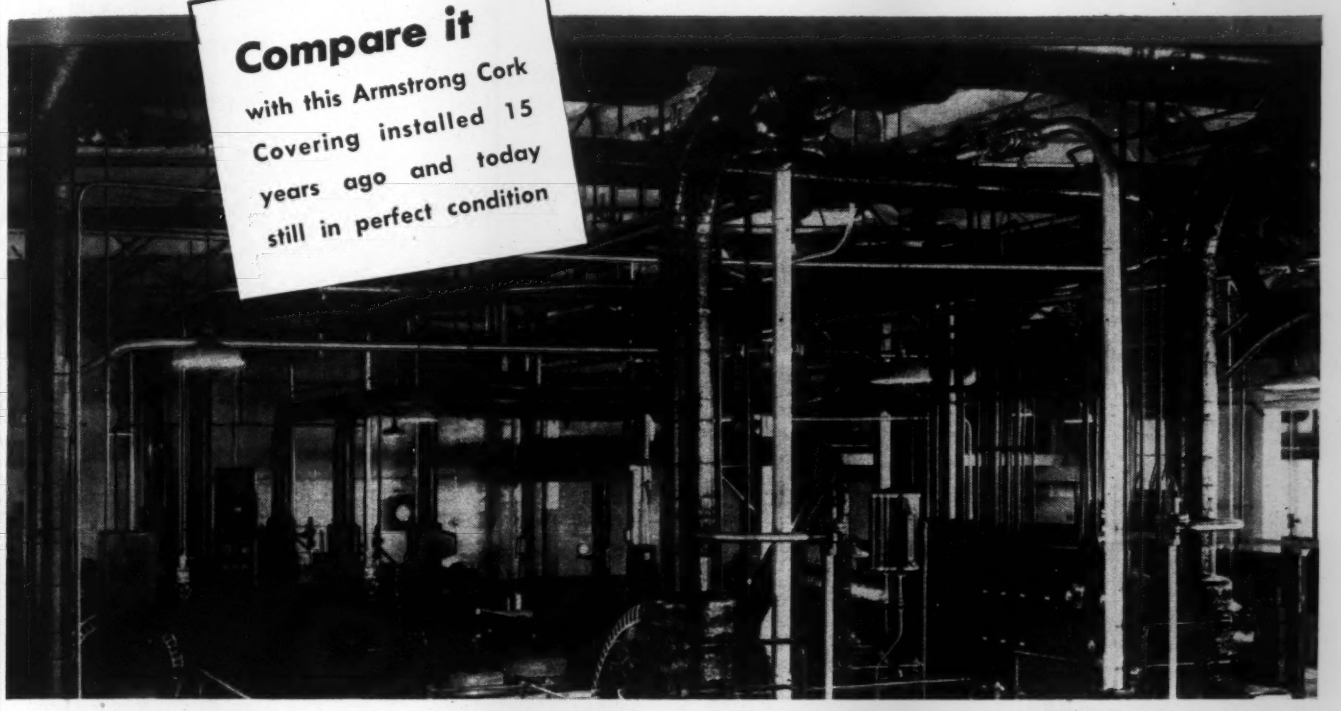
No. 4897—Leaflet (117) devoted to air operated tools for maintenance, construction, and demolition, showing at a glance the manufacturer's line of "I-R" air tools and portable compressors.—Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Air Recovery

No. 4898—Leaflet explaining what air recovery means to design engineers, architects, plant engineers, and contractors, and describing how "Dorex" units work and their applications.—W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y.

†Copies of this catalog available only on direct request to the manufacturer on company letterhead.

Did you buy any cold line insulation in 1929?



After 15 Years of service, Armstrong's Cork Covering on cold lines in the Security Warehouse and Cold Storage Plant, Santa Clara, Cal., is still solid, dry, efficient. This insulation has had normal maintenance and care, including regular annual painting. But its remarkably fine condition is also due to the inherent durability of the molded cork itself.

Clean granules of pure cork are compressed and baked to make Armstrong's Cork Covering. This insulation has low thermal conductivity and high natural resistance to moisture. It is fire resistant, light in weight, structurally strong.

Armstrong's Cork Covering comes in 3 standard thicknesses: Special Thick Brine, Brine, and Ice Water—to hold temperatures from 25° F. below zero to 35° F. Each of the three thicknesses is made to fit standard pipe sizes and copper tubing from ¼" up, with fitting covers to match. For full information, write today to Armstrong Cork Co., Building Materials Division, 4403 Concord St., Lancaster, Penna.

Armstrong's Cork Lagging installed on shell cooler at Security Warehouse, Santa Clara, Cal., in 1929 at the same time as the cork covering shown above. The photographs were taken June 1944.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2600° Fahrenheit

Arc Welders and Pipe Thawers

No. 4899—Leaflet describing "Klondike" a-c arc welders and pipe thawers, with information and prices on various models. Also, leaflet on electric pipe thawing machine for thawing out frozen water pipes, hot water systems, radiator systems, air lines, etc.—Ralph Fern, 2517 Boulevard Ave., Scranton 9, Pa.

Belting

No. 4900—2 p. leaflet showing belting thicknesses and correct sizes of fasteners for transmission and conveyor belting.—Baldwin Belting, Inc., 85 Chambers St., New York 7, N. Y.

Color for Piping System Identification and Safety in Industrial Plants

No. 4901—Booklet discussing the subject of "color power" for industry and presenting the story of "Optonic" colors. Also, 12 p. booklet comprising a practical guide to the use of the "Optonic" color system. Also, 8 p. bulletin on a safety color code for industrial plants. Also, 8 p. bulletin presenting a standard code for identification of piping systems adapted from the scheme for identification of piping systems sponsored by the ASME.—Arco Co., 7301 Bessemer Ave., Cleveland 4, Ohio.

Copper Pipe and Fittings

No. 4902—2 p. Producers' Council bulletin (47) on "Streamline" copper pipe and fittings, with information on capacity, heat loss, physical properties, expansion and contraction, vibration, and cost.—Mueller Brass Co., Port Huron, Mich.

Corrosion and Contamination

No. 4903—Issue of Bakelite Review dated January, 1945, with an article by Charles G. Munger, chief chemist, American Pipe and Construction Co., on the use of "Vinylite" resin coatings for protecting containers from corrosive liquids and preventing contamination of liquids by containers. Among the applications of these coatings is protection of aviation gasoline stored in underground concrete tanks.—Bakelite Corp., 30 E. 42nd St., New York 17, N. Y.

Dryers

No. 4904—Issue of the Reznor News (Vol. 4, No. 12) with article on a high velocity dryer which utilizes duct type heaters.—Reznor Mfg. Co., Mercer, Pa.

Dust Collectors

No. 4905—2 p. bulletin on unit dust collectors for installation on grinders, buffers, sanders, polishers, lathes, and other machines, handling 500 cfm. The filter consists of 20 layers of viscous coated paper. Dimensions are 20 in. by 20 in. by 38 in. high.—Ideal Commutator Dresser Co., 1096 Park Ave., Sycamore, Ill.

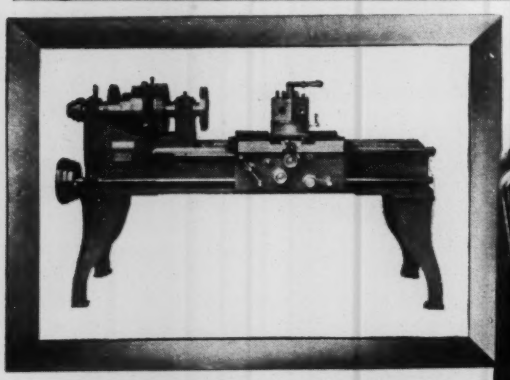
Fans

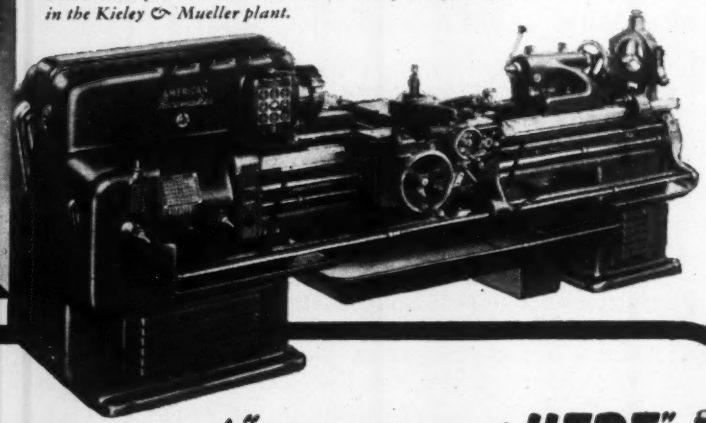
No. 4906—8 p. bulletin (F-9) covering ventilating and duct type fans, describing the new "Wingfoil" fan wheel, straight line duct fan, and elbow type duct fan. Many types of installations are shown. There are capacity tables, dimensions, and engineering data.—L. J. Wing Mfg. Co., 14th St. and 7th Ave., New York 11, N. Y.

Feedwater Treatment

No. 4907—12 p. reprint from official proceedings of the Master Boiler Makers' Association on internal feed-

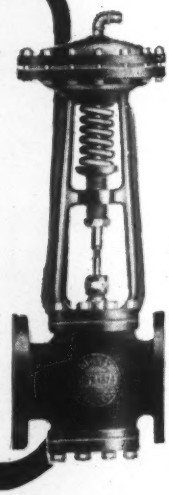
In 1878 the founders of The American Tool Works Company began the manufacture of lathes. At left is an 1890 model. Below is the famous American Pacemaker of today, as used in the Kieley & Mueller plant.





67 years of improvement...and "it comes out HERE"

Here? Yes, for the *real* advancement in lathe design is in the better, more accurate products those lathes make. Just as the real improvement in Kieley — Mueller Controls is not in the controls themselves . . . but in most accurate and dependable pressure regulation in actual application. So when you look at the illustration of our Type 418 Pressure Regulating Valve at the right, please look behind it . . . and *ahead!* Look behind it to Kieley & Mueller's own 66 years of experience and improvement. Look ahead to the long years of reliable performance Type 418 will give you on any standard service where inlet pressure, constant or varying, does not exceed 300 lbs. . . . and where reduced pressure range is from 1 lb. to 75% of inlet not exceeding 125 lbs. Type 418 is made in ½" to 12" sizes, single or double seated, with discs suitable for water, air, gas, oil, steam or corrosive fluids. Complete details and specifications in Catalog No. 66. Write for it.



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2015 43rd Street North Bergen, N. J.

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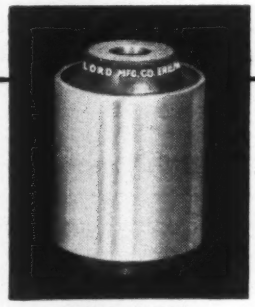
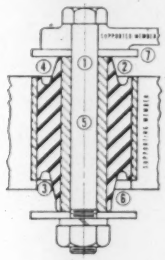
For Better Control of Vibration

LORD
SHEAR TYPE
Bonded Rubber
MOUNTINGS

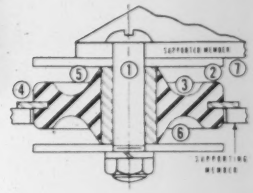


TUBE FORM



1. **End Extensions**—Provide clearance between the metal members for free movement in shear.
2. **End Shape**—Throws flexing action away from the metal parts into the rubber body, preventing stress concentration at the edge of the bond.
3. **Rubber-to-Metal Bond**—Lord Methods produce a high ratio of bond strength to working stress, resulting in a large factor of safety.
4. **Rubber Compounds**—Developed particularly for shear type mountings and may be changed in properties to suit a wide range of conditions.
5. **Center Sleeve**—Dimensions may be changed to meet any unique installation conditions.
6. **Sound**—Use of Lord mountings eliminates noise normally transmitted through solid metallic paths.
7. **Safety**—Metal washers, installed as shown, limit movement under ordinary overload or shock. If excessive overloads cause the rubber to fail, the suspended member will not be released without breaking one of the metal parts.

PLATE FORM



1. **End Extensions**—Provide clearance between center metal member and rubber Snubbing Shoulders for free movement in shear.
2. **Snubbing Shoulders**—Arrest shock movement and supply a cushioned stop on contact with metal washers.
3. **End Shape**—Throws flexing action away from metal parts into the rubber body, preventing stress concentration at the bond.
4. **Rubber-to-Metal Bond**—Lord Methods produce a high ratio of bond strength to working stress, resulting in an ample factor of safety.
5. **Rubber Compounds**—Developed particularly for shear type mountings may be changed in thickness of body and in properties to suit a wide range of conditions.
6. **Sound**—Use of Lord mountings eliminates noise normally transmitted through solid metallic paths.
7. **Safety**—Metal washers, installed as shown, make up an inter-locking system of metal parts, which limit and cushion excessive movement under conditions of overload or shock.

FOR more than twenty years Lord's business has been the isolation and control of vibration. Lord has lifted the methods of attack on the destructive forces of vibration to a highly developed science. When Lord engineers make a study of your plant or your product, there's no guesswork about their recommendations.

Lord's *Bonded Rubber* Shear Type Mountings embody many exclusive patented features available only in Lord Mountings. Typical methods of installation and design features are shown above. Lord's special bonding process insures a bond between rubber and metal that is as strong or stronger than the rubber itself. The contour of the rubber element is designed to throw flexing action away from the metal parts into the rubber body, preventing concentration of stress at the edge of the bond. Countless formulae developed through years of experience and scientific control of compounding methods enable Lord to produce a rubber body with the exact degree of stiffness and other qualities needed for the job the mounting is required to perform. Lord's bonding process leaves the rubber body in a natural state of rest, with no "built-in" stresses of tension, compression or torque, to detract from its full potential in combatting the forces of vibration over a long service life.

If you have a vibration problem, or a mechanical design problem involving the use of functional rubber, it may best be solved by means of rubber-bonded-to-metal. Call in a Lord Vibration Engineer, or write for literature on the subject. There is no obligation.

BUY EXTRA WAR BONDS

IT TAKES **BONDED RUBBER** *In Shear* TO ABSORB VIBRATION

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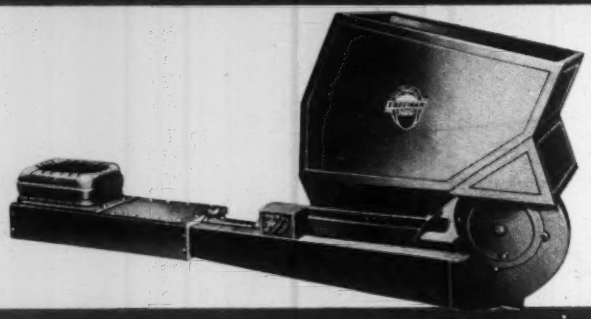
FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS



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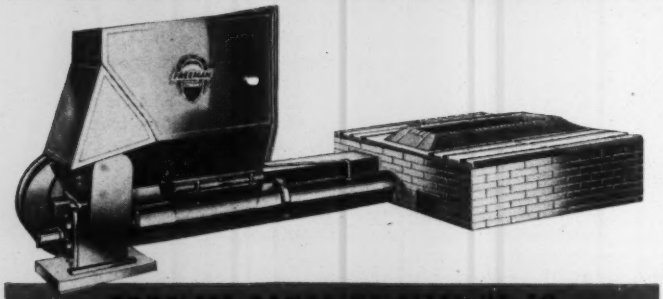

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water treatment of locomotive boilers, by Jean de Frank. Methods of preventing scale and corrosion are discussed, emphasis being placed on production of pure steam, prevention of foaming, and elimination of excessive blowdown.—American K. A. T. Corp., 331 Madison Ave., New York 17, N. Y.

Feedwater Treatment

No. 4908—4 p. reprint (37) of an article on feedwater treatment for high pressure boilers at the Dow Chemical Co., by L. F. Wirth and C. E. Joos.— Cochrane Corp., 3131 N. 17th St., Philadelphia 32, Pa.

Flange for Flexible Metal Hose

No. 4909—2 p. leaflet describing new detachable flange for helical flexible metal hose in sizes of 2, 2½, and 3 in. ID and designed to permit repeated re-use. Assembly is by means of ordinary shop tools.—Packless Metal Products Corp., 31 Winthrop Ave., New Rochelle, N. Y.

Forced Draft Blowers and Auxiliary Turbines

No. 4910—8 p. bulletin (SW-1) on forced draft blowers, both turbine and motor driven, and auxiliary turbines, with photographs of installations, capacity curves, dimension tables, and operating data.—L. J. Wing Mfg. Co., 14th St. and 7th Ave., New York 11, N. Y.

Gas Welding and Cutting Apparatus

No. 4911—104 p. catalog of gas welding and cutting apparatus with complete information and numerous illustrations of a wide variety of equipment.—Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif.

Heaters and Coolers

No. 4912—12 p. bulletin (35-76B) on "Adsco" heaters and coolers—including three new types—with dimensions, capacity tables, and list prices for units suitable for use as instantaneous heaters, condensate coolers, preheaters, fuel oil heaters, etc.—American District Steam Co., 25 Bryant St., North Tonawanda, N. Y.

Insulating Glass Units for Windows

No. 4913—16 p. bulletin on "Thermopane," a transparent insulating glass unit for windows with information on the "Bondermetic" seal, other features of the product, information on and illustrations of applications, and with tables of sizes, thicknesses and weights, and information on heat transmission. Also 16 p. bulletin of Don Graf's technical sheets on this product, with information on heat loss reduction, glass surface temperature, strength, light quality, installation and general data, manufacture and service.—Libbey-Owens-Ford Glass Co., Nicholas Bldg., Toledo 3, Ohio.

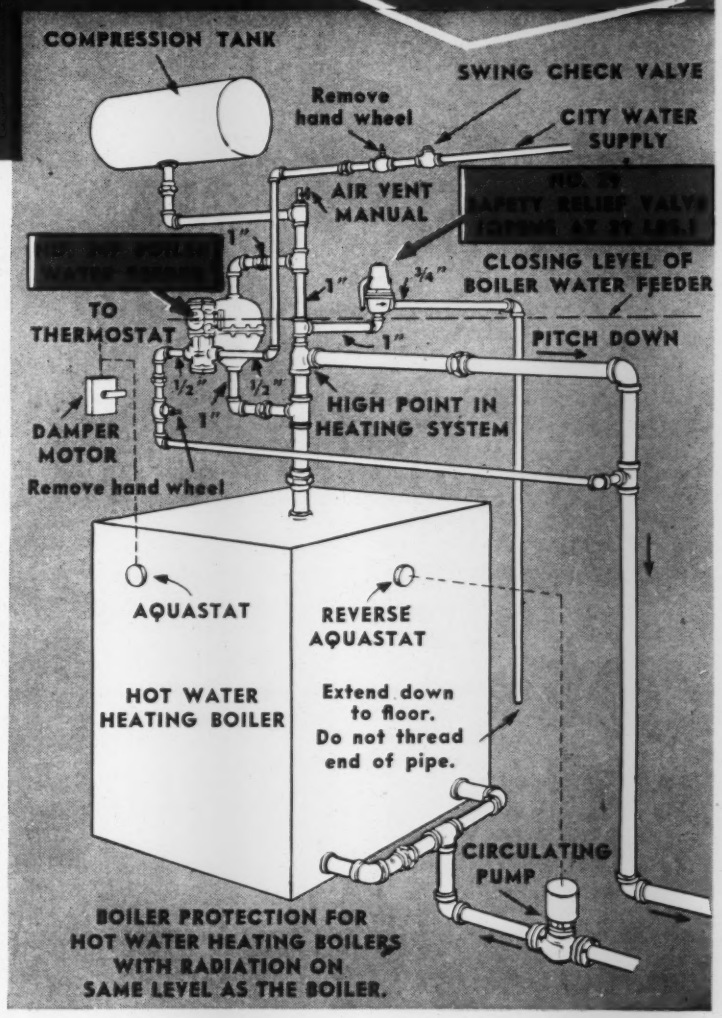
Motors

No. 4914—16 p. bulletin on the care and application of fractional horsepower motors.—Bodine Electric Co., 2254 W. Ohio St., Chicago 12, Ill.

Motors

No. 4915—4 p. bulletin describing a new protected type motor designed for both drip-proof and open motor applications. A cutaway view of the motor showing vari-

How can you properly protect this type of HOT WATER heating system?


COMPRESSION TANK
SWING CHECK VALVE
Remove hand wheel
CITY WATER SUPPLY
AIR VENT MANUAL
CLOSING LEVEL OF BOILER WATER FEEDER
TO THERMOSTAT
PITCH DOWN
HIGH POINT IN HEATING SYSTEM
DAMPER MOTOR
Remove hand wheel
AQUASTAT
REVERSE AQUASTAT
HOT WATER HEATING BOILER
Extend down to floor. Do not thread end of pipe.
CIRCULATING PUMP
BOILER PROTECTION FOR HOT WATER HEATING BOILERS WITH RADIATION ON SAME LEVEL AS THE BOILER.

MANY of these hot water heating plants with radiation on the same level as the boiler have been installed recently, and more of them are going in every day. The schematic drawing opposite shows the usual arrangement — and it is worth studying. It is an arrangement that provides an excellent heating system, but there have been frequent cases of boiler breakage in plants of this type where steps were not taken to guard against the conditions which cause trouble. For properly protecting this type of plant—

—the answer is the McDonnell No. 247 Boiler Water Control and No. 29 Safety Relief Valve

When trouble was reported in plants of this type, we immediately conducted an exhaustive study of operating conditions. The outcome was the application of McDonnell Equipment as pointed out by the red arrows. A McDonnell No. 247 Feeder is positioned so that it constantly maintains a water level above the high point in the main. Pressure in excess of 30 lbs. is prevented by the McDonnell No. 29 Safety Relief Valve installed as shown.

Tests have been run in which all hazardous conditions were reproduced. As a result of these tests, as well as extensive use under typical conditions, it has been fully proved that the method protects systems of this kind from boiler damage due to excess pressure, over-firing or power failure.

The features of design and construction of the No. 247 Boiler Water Control and the No. 29 Safety Relief Valve are briefly covered below. Always important, the protection of all-but-irreplaceable steam boilers, hot water boilers, heaters, and tanks is many times more vital today. Ask for recommendations and installation drawings covering any type of boiler, tank or heater needing protection.

McDONNELL & MILLER, 1316 Wrigley Building, Chicago, Illinois

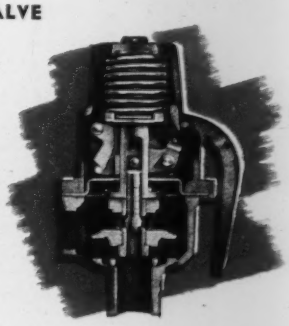
NO. 247 BOILER WATER CONTROL

This boiler water control, used in installations of the type shown above, incorporates the basic features of all McDonnell boiler water feeders such as straight-thrust valve action, double sylphon construction which eliminates packing, large built-in strainer, etc. It is installed with one-inch equalizing pipe. Maximum body pressure is 30 lbs. There is a type of McDonnell Boiler Feeder, Low Water Cut-off, Low Water Alarm, or Liquid Level Control for every need.

No. 29 SAFETY RELIEF VALVE

The McDonnell No. 29 Safety Relief Valve has the McDonnell Snap Action which opens up full orifice capacity when set pressure of 29 lbs. develops, assuring prevention of excess pressures in systems of the type illustrated.

All McDonnell Relief Valves have the snap action mechanism illustrated above which assures opening up of full capacity at set relief pressure. As a result, they are accurately rated in DISCHARGE CAPACITY so that they can be properly matched to boilers and tanks as required by the A.S.M.E. Boiler Code. In addition to the No. 29, which opens at 29 lbs. pressure, the series includes: No. 229, opening at 75 lbs. pressure; No. 329, opening at 100 lbs.; No. 429, opening at 150 lbs.



Doing One Thing Well

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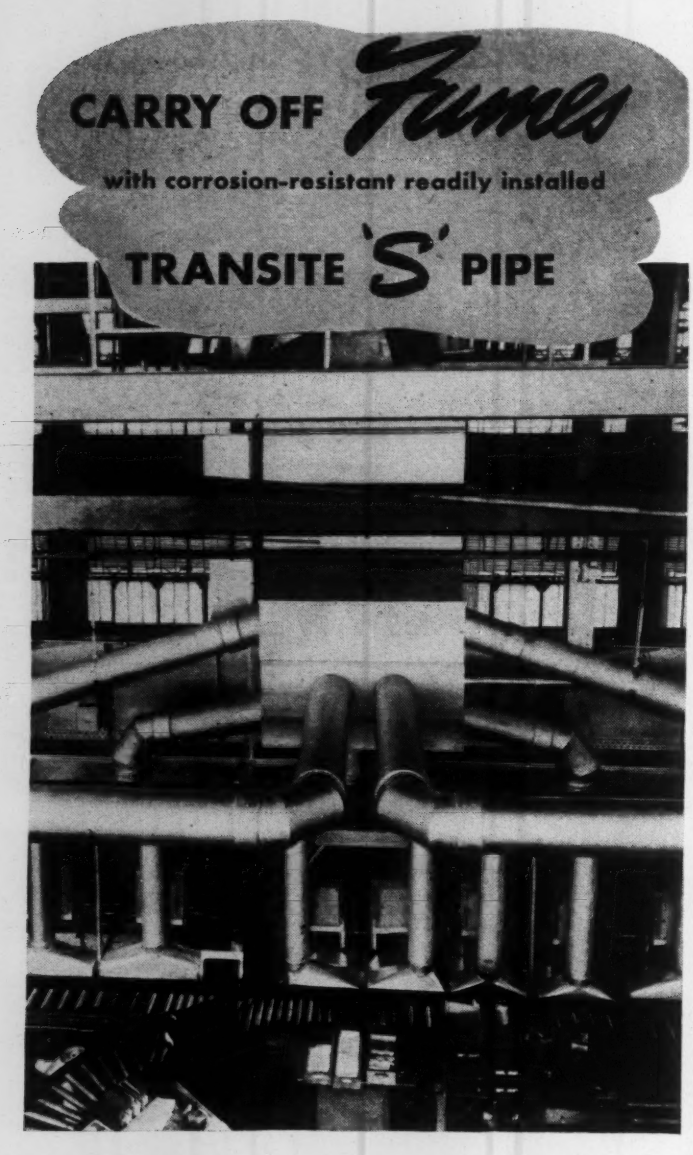
McDONNELL *Boiler Water Level* CONTROLS



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ous features is included—Crocker-Wheeler Electric Mfg. Co., Div. Joshua Hendy Iron Works, Ampere 1, N. J.

Oxyacetylene Pipe Line Distributing Systems

No. 4916—84 p. book giving a comprehensive review of the subject of oxyacetylene pipe line distributing systems from the production of calcium carbide and acetylene gas to the equipment needed for oxyacetylene distributing systems. Free circulation of this book is restricted to engineers and welding department supervisors.—Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif.

Spreader Type Stokers

No. 4917—4 p. bulletin (441-S) on "J & J" spreader type stokers, which feature "a leakproof and dust tight coal feeder, combination mechanical-pneumatic coal distributing system that distributes lump and fines to all parts of the grate area, air cooling of all parts, and easy accessibility for inspection and maintenance."—Johnston & Jennings Co., 877 Addison Road, Cleveland 14, Ohio.

Steam Condensers

No. 4918—1 p. bulletin (99) on "Aero" steam condensers, showing a diagram of the operation of this new product.—Niagara Blower Co., 6 E. 45th St., New York 17, N. Y.

Thermostatic Controls

No. 4919—20 p. booklet (B3344) describing applications of seven types of bimetal thermostats for automatic control of temperatures up to 650 F. Characteristics and capacities of each unit are discussed and tabulated for easy selection.—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Vacuum Heating Systems

No. 4920—32 p. bulletin (631) of technical data on the differential vacuum heating system containing up to the minute data on "this time-tried system which uses 'flexible steam'." There is also a section on the "Metro" method of piping which has been used in large housing projects (including Parkchester). There is information on the functions of differential equipment, general design information, pipe sizing tables, valves and traps, piping connections, and dimensions, control equipment, etc.—C. A. Dunham Co., 450 E. Ohio St., Chicago 11, Ill.

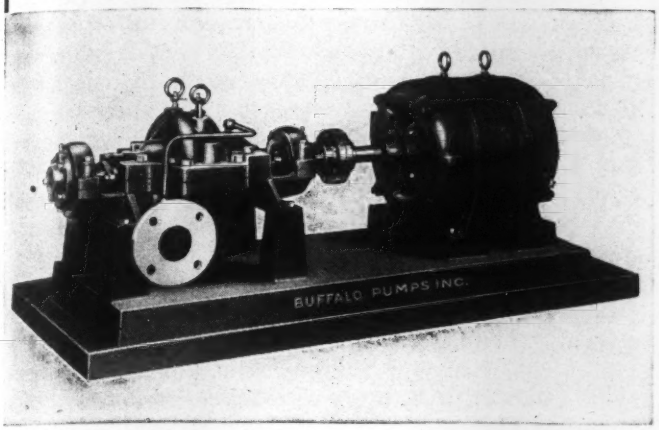
Vertical Turret Lathes

No. 4921—16 p. bulletin describing the new "Man-Au-Trol" vertical turret lathe, which according to the manufacturer, is an automatic control that is as versatile as manual control.—Bullard Co., 286 Canfield Ave., Bridgeport 2, Conn.

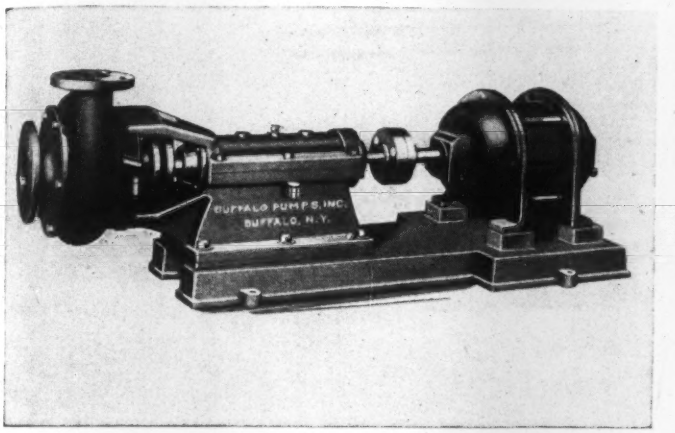
Welding

No. 4922—24 p. booklet illustrating common faults found in designs for arc welding, with many practical suggestions. Also, 24 p. booklet answering the question "Can you patent a welded design?"—Hobart Brothers Co., Troy 1, Ohio.

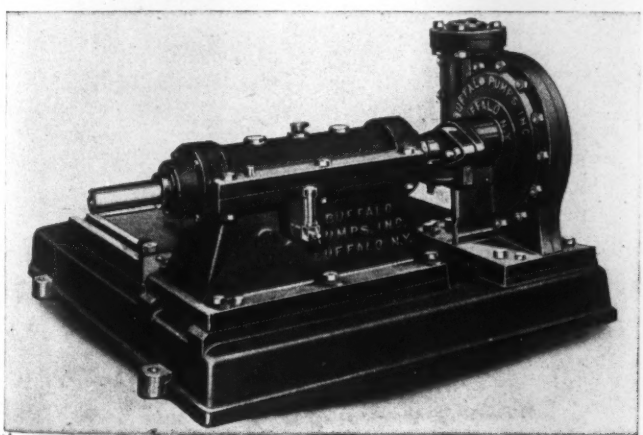
Three popular pumps—



Buffalo Class "RR" Pumps are commonly used for boiler feeding and general service where clear water is handled. They are built in two- and four-stage models, with single suction impellers mounted back to back, so that practically perfect hydraulic balance is obtained. Extra heavy duty construction is a feature of this line; all parts are amply proportioned so that continuous operation is practical. "RR" pumps are efficient;—the No. 3 two-stage, for example, handles 400 gpm against 500 feet head at 3,500 rpm, with an efficiency of 75%. Complete information on "RR" pumps is contained in Bulletin 980.



Buffalo Single Suction Full Ball-Bearing Pumps are paper mill and chemical plant favorites. Available with open or enclosed impellers, for construction in iron, bronze, stainless steel, nickel, Hastelloy "B" and "C" and other machineable alloys, but not in all lead, these pumps also feature heavy-duty construction for hard service. Stuffing boxes can be modified to suit each particular application, and can be supplied with water seal and also with mechanical rotary stuffing box seals. Shaft is protected from wear by a removable shaft sleeve. Shaft flinger provides additional bearing protection. Full details on these pumps are contained in Bulletin 982.



Buffalo Lead Acid Pumps have enclosed impellers and full ball-bearing construction. They are used for hot or cold sulphuric acid, sulphurous acid, alum, ammonium-sulphate and copper sulphate. Stuffing boxes are not less than 3″ deep, and are made to suit each specific installation. Impeller and pump casing are designed so that even when of all-lead construction relatively high impeller speeds and casing pressures are easily withstood.

While designed primarily for all lead construction, these pumps can also be built in all iron or special alloys. Full details on construction are in Bulletin 982.

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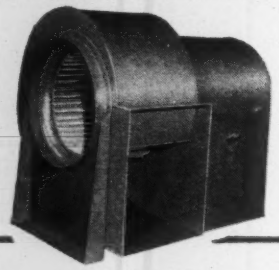
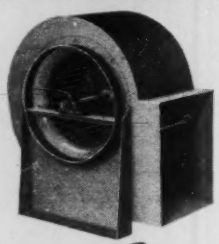
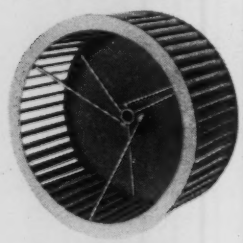
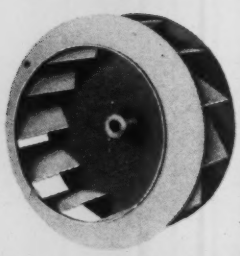




Peerless Electric
VENTILATING BLOWERS
SIZES 12" to 48"
Shown here in Arrangement 3





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Forward curve and backward curve blower wheels full welded construction carefully balanced for smooth, quiet rotation.

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Belt drive units are powered with ½ to 7½ h.p. motors; direct drive units ½ to 2 h.p. motors. All units supplied with or without weatherproof hood covers for drive mechanism.

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• WPB . . . OPA . . . PAW . . . Etc. •

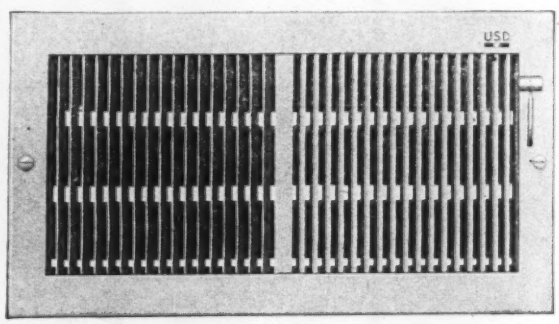
Fuel Oil for Nonresidential Space Heaters

There will be no further issuance of fuel oil rations for use in space heaters that furnish heat or hot water in nonresidential premises, where the ration would be 10,000 gal or more a year, except under special conditions, the Office of Price Administration announced February 26.

The revised ruling provides that unless the applicant first obtains an exception order from the Petroleum Administration for War, OPA will not issue rations for space heaters in nonresidential premises using 10,000 gal or more a year if the heaters were installed or converted to the use of fuel oil after February 26, 1945. The change is in line with similar provisions being made by PAW in its petroleum distribution order No. 13, and was requested by that agency.

Individual householders who use space heaters are not affected by the new restriction, OPA pointed out.

A small group of industrial users of fuel oil are the only consumers affected. Most industrial consumers, OPA said, use central heating equipment. Under the former provisions, however, industrial consumers who could get new oil burning heaters or convert other stoves to the use of oil were eligible for rations and so could heat their plants with a number of space heaters. Because of the acute shortage of fuel oil, no new rations



No. 4432

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AIR DIRECTIONAL REGISTERS

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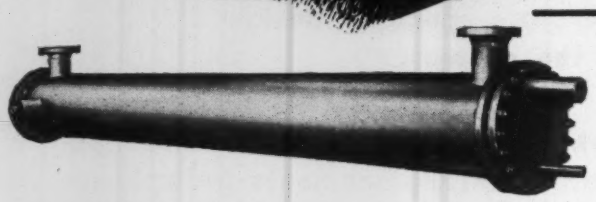
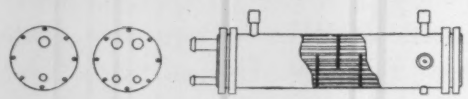
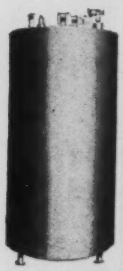


BAFFLE SPACING ASSURES HIGH EFFICIENCY



Designed especially for cooling recirculated water in air conditioning systems of the indirect type and for processing water in large volume. Shell and baffled tube construction, baffle spacing being determined by the actual water flow required. Direct expansion. Non-freeze. Only a small refrigerant charge required. A full range of capacities. Write for Catalog No. 5-A.



HI-PEAK WATER COOLERS

These shell and coil remote type water coolers assure ample reserve volume of properly cooled water ready for instant delivery at all times. Sweat fittings are silver soldered. All pipe connections welded to shell. Galvanized inside and outside after fabrication. Storage capacities 12 to 168 gallons. Write for Catalog No. 25.

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for such use will be issued without special approval of the PAW. (Amendment 46 to revised ration order 11—fuel oil—effective March 2, 1945.)

How Natural Gas Crisis Was Met

Cooperative effort by utility companies, industrial consumers, and the general public with the WPB's office of war utilities will be necessary throughout the remainder of the winter if a disastrous collapse of natural gas service in the industrialized areas of the midwest is to be averted, J. A. Krug, WPB chairman, said February 6.

"Such a collapse was averted in western New York, Ohio, and Pennsylvania last week by a margin of only a few hours," Mr. Krug said. "That it was averted was due to the prompt and efficient way in which the office of war utilities moved in on the situation and to the splendid wholehearted cooperation which was forthcoming from public utilities, industrial consumers, and the general public."

Any general failure of a natural gas system in a heavily industrialized area, Mr. Krug said, would involve the loss of millions of dollars, the crippling of much critical war production, and widespread danger to human life.

Mr. Krug made these comments in making public a report submitted to him by Edward Falck, director of the office of war utilities. The report on "the natural gas crisis, January 29-February 5, 1945," follows:

"During the week beginning Monday, January 29, continuance of the severe weather conditions throughout the Appalachian area caused tremendous demands

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upon the natural gas systems, accentuated by the shortages in other fuels. Many systems from Buffalo to New York down through the Ohio valley were under such strain that pressures could not be maintained and every effort was made through interconnections to bolster up sagging portions of the natural gas lines.

"Heavy curtailments in war production loads were necessary in order that any service at all could be maintained. Throughout the period, directives were issued by WPB under utilities order U-7 authorizing one system to transfer gas to another in an effort to prevent the complete collapse. On Thursday afternoon, February 1, it became apparent that the shortage had increased to such a degree that all systems might fail with resultant disastrous conditions in many communities. Steps therefore were taken at once to make available all of the sources of gas throughout adjacent areas in order to prevent such a disaster, which, if it happened, would cause a long delay in resumption of war production from West Virginia to the Great Lakes.

"At 4:10 p. m., on Thursday, February 1, the Panhandle Eastern Co., which serves Indiana, Illinois and Michigan, was instructed to deliver all gas made available from full curtailment of loads, including war producers, in order to save the Columbia and Consolidated gas systems, which supply most of the larger cities throughout the Ohio valley, including Pittsburgh. The Panhandle Eastern Co. in turn directed the Michigan Consolidated Gas Co., which supplies Detroit, to institute complete curtailments, including gas deliveries to war producers throughout the area, in order that the gas might be diverted to prevent collapse of the Appa-

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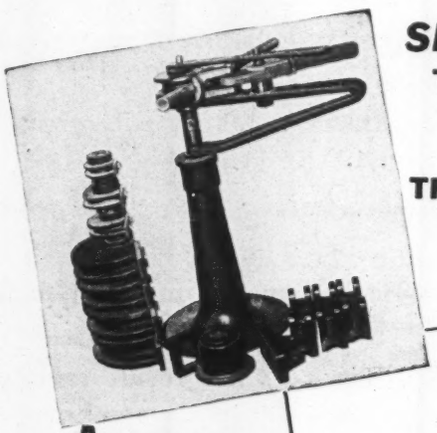

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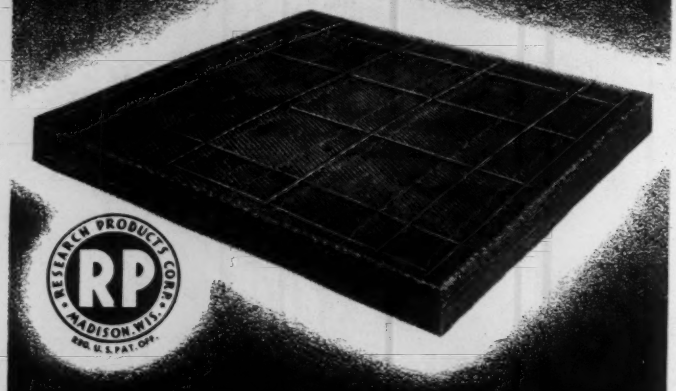
I·B·R

STOP MORE DUST



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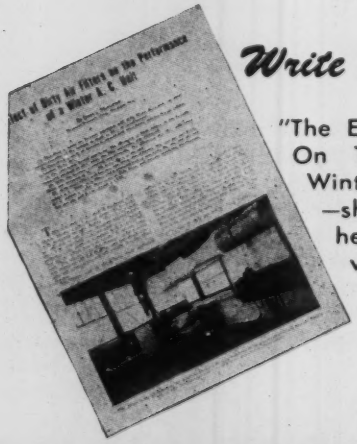

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lachian system. In consequence of this, the war plants in Detroit were shut down and many workers were sent home. The gas made available from Detroit was a material factor in saving the other systems from complete collapse.

"Late Friday afternoon weather reports indicated that a coming break in the weather Friday night, followed by moderation Saturday morning, would show reduced gas demands throughout the Appalachian area so as to permit resumption of service in Detroit. Accordingly at 3 p. m. on Friday evening, February 2, the suppliers were directed to lift the curtailments. There was no confusion in the issuance of orders. They were deliberately aimed to prevent a disaster to war production in many cities. In this solution the cessation of a few hours' service in Detroit was fully taken into consideration.

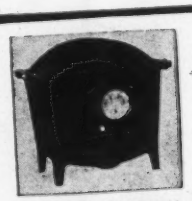
"If severe weather conditions again occur, it may be necessary to resort to similar measures in order that continued war production dependent on gas supplies may be fully protected."

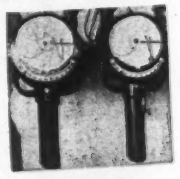
Construction Limitations Changed

Changes in the construction limitations applicable to authorized building projects, which reflect recent modifications in WPB orders governing materials and equipment used in construction, have been incorporated in an amendment to schedule A to controlled materials plan regulation No. 6, WPB reported February 21.

The revised restrictions are applicable to all construction authorized on form GA-1456 on or after February 17, 1945, following approval on form WPB-617.

CONSERVE FUEL
by detecting waste with
ADSCO METERS


ADSCO ROTARY CONDENSATION METER


ADSCO FLOW METER

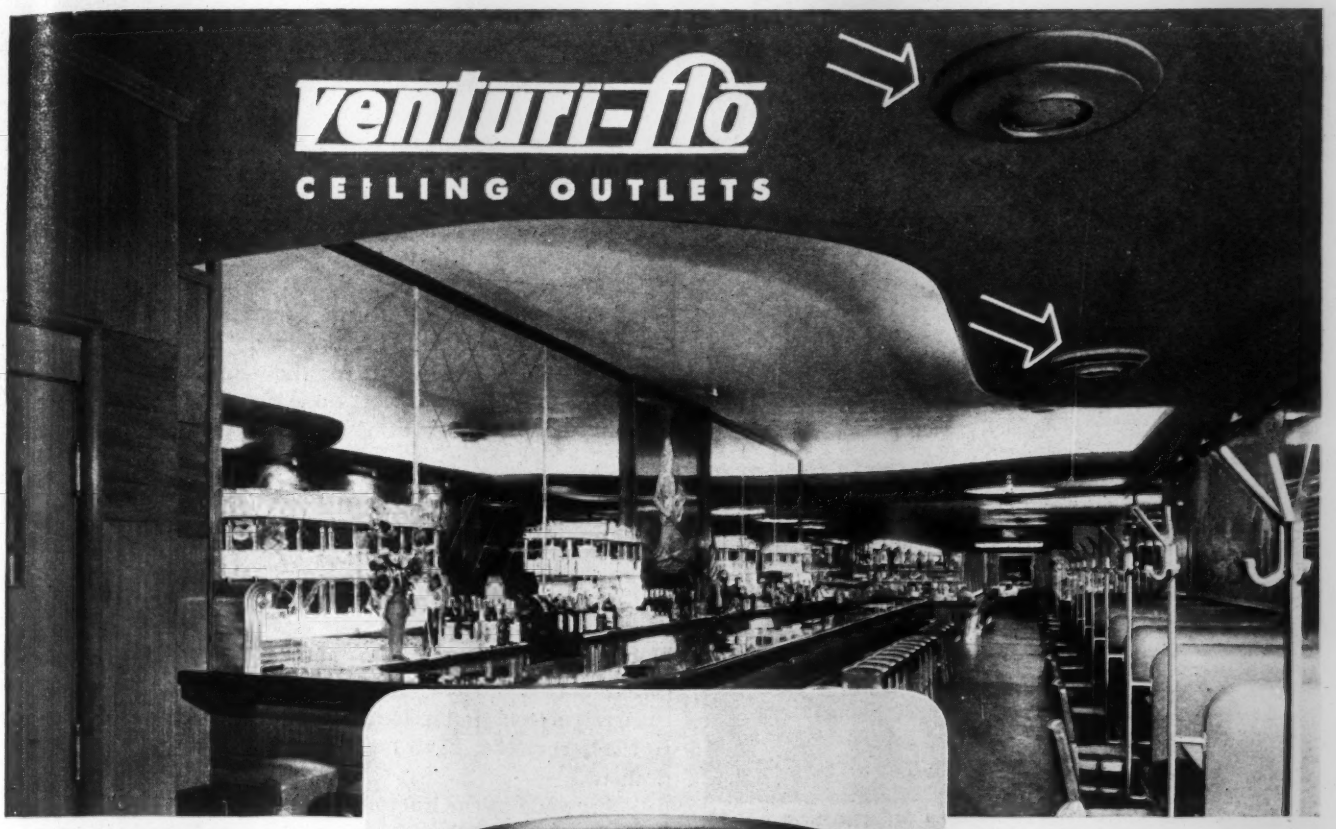
Present manpower and transportation conditions make it imperative to conserve fuel. The first requirement is to detect waste and inefficiency by installing adequate metering equipment.

THE ADSCO ROTARY CONDENSATION METER provides the most economical means of determining steam consumption wherever it is possible to collect the condensate from steam heating or processing lines in a building or department.

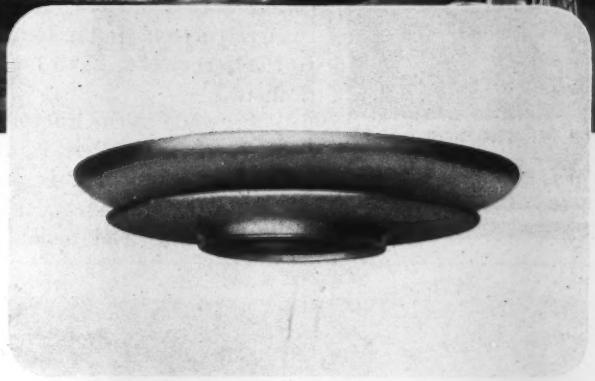
THE ADSCO FLOW METER is designed for Steam, Water, Air or Gas. Recommended where a 24-hour visual chart record of flow, an indication of the pressure and a totalization of the flow through the line is desired.

Write for Bulletins 35-80 and 35-83HP.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N. Y.



Above, the Katsinas Cafe in Springfield, Illinois. It is 160 feet long, 18 feet wide, and seats 200 people.



Left, Barber-Colman VENTURI-FLO Ceiling Outlet of the type used as overhead air diffusers in the Katsinas Cafe.

BARBER-COLMAN venturi-flo CEILING OUTLETS

PROVIDE PROPER AIR SUPPLY IN LONG AND NARROW SPACES

HOW to properly heat and ventilate a restaurant is often a difficult engineering problem, especially when the space is long and narrow like the 18-by-160-foot room shown above. With smoke, food odors, patron comfort, and rapid occupancy changes to consider, the problem calls for high-capacity, draft-preventing air diffusers. Wall area is usually at a premium and conformity with artistic decorations must also be thought of. On all these counts, VENTURI-FLO Ceiling Outlets meet today's — and tomorrow's — requirements. Data based on field and laboratory tests enables us to recommend exactly the outlet for any condition and to GUARANTEE satisfactory results. You are assured of uniform, properly diffused air at the desired temperature at specified level, with required air movement, and prevention of too hot, too cold, or drafty areas.

venturi-flo
CEILING OUTLETS

For *guaranteed* satisfaction, use Barber-Colman ENGINEERED AIR DISTRIBUTION. See your Barber-Colman representative or our complete catalog in Sweets' 1945 architectural file.

BARBER-COLMAN COMPANY
1228 ROCK STREET • ROCKFORD, ILLINOIS

HOT MOULDED ALUMINUM
. . . requires temperature control
Fenwal THERMOSWITCH helps remove wrinkles from wing-section assemblies. Unit control heaters regulated by THERMOSWITCH stretch aluminum.

Write for catalogue and complete information . . . to

Fenwal INCORPORATED ASHLAND • MASS.

In addition, a builder whose authorization was issued before that date may take advantage of any provisions of the amendment. The changes also apply to certain utility construction controlled by WPB order U-1 (utilities). They do not, however, apply to housing construction authorized by the National Housing Agency. Such housing is subject to limited preference rating order P-55-c, and not to schedule A of CMP regulation No. 6, WPB pointed out.

Form GA-1456 is used to authorize most commercial, industrial, and agricultural construction controlled by conservation order L-41, the basic construction order. Other forms are used for housing construction approved by NHA, for certain Army and Navy construction, and for a few other specialized kinds of construction.

Because of the current shortages of sheet steel, the amended schedule restricts the use of various fabricated items made of sheet steel and strip, including doors, electric metallic tubing, partitions except toilet partitions, raceways and other items. It also restricts the use of fencing, tanks, and tank towers. Restrictions on the use of metal lath, which were contained in the May 23, 1944, and August 7, 1944, issues of the construction limitation, but omitted in the October 31, 1944, revision, have been reinstated in the new amendment.

Plywood form liners are now prohibited, but tongue and groove lumber is permitted for forms where used lumber or plywood is not available. Western pine lumber is prohibited except for certain millwork. The use of lead and lead products is prohibited except for cer-

50,000 to 10,000,000 B.t.u. with WECO-N.G.E. Series F600

GAS BURNERS. For use in heating heating boilers, power boilers—in any metal firebox or sectional boiler.

Adaptable to any firebox shape or size.

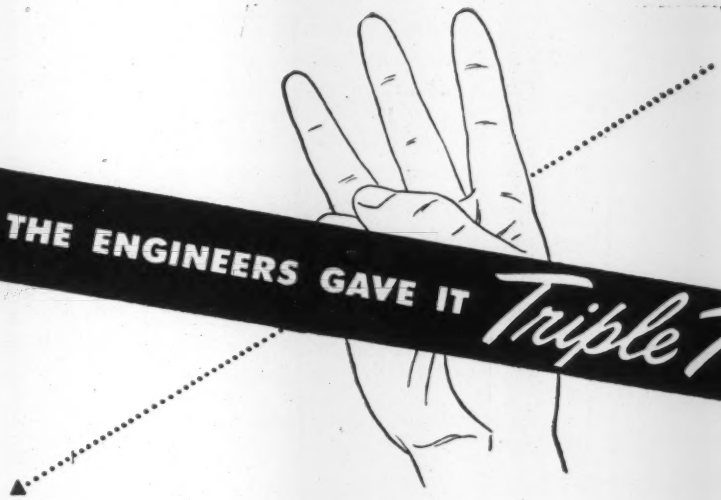
Handles various gas pressures and effects low draft loss.

The Series F600 Burner operates on straight natural gas and mixed gas to 800 B.t.u. Gives perfect horizontal distribution. Full automatic controls—that operate properly—can be easily applied.

THE WEBSTER ENGINEERING CO.

TULSA —DIVISION OF— OKLAHOMA

Surface Combustion . . . . . Toledo, Ohio



WHY THE ENGINEERS GAVE IT *Triple Protection*

It didn't take much selling for the engineers on this job to decide that ARMCO Galvanized PAINTGRIP was the sheet metal to use for exposed air-ducts and other construction.

For one thing, they found out that *it actually costs less to use* PAINTGRIP than to specify ordinary galvanized steel and acid-treat the work before painting. Besides, this etches the zinc, robs it of full protection.

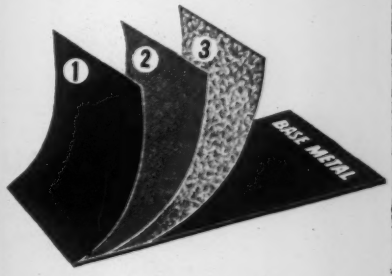
But the important thing is, ARMCO Galvanized PAINTGRIP can be painted as soon as the work is up and preserves the paint several times longer than paint on untreated galvanized steel. The sheets are Bonderized at the mill and ready for your most exacting specifications.

Your sheet metal contractor can work, form, solder or weld PAINTGRIP as satisfactorily as regular galvanized steel. But best of all, he can better prepare the job for the painter and assure you and your clients of years of trouble-free service.

It'll pay you to remember ARMCO Galvanized PAINTGRIP for your post-war sheet metal work. Shall we send you more information? The American Rolling Mill Company, 861 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

The engineers on this telephone exchange job in Jackson, Mississippi, learned that it actually costs less to use ARMCO Galvanized PAINTGRIP sheets for exposed ducts than to acid-treat before painting. And the neutral Bonderized surface holds paint much longer.



PAINTGRIP AT A GLANCE

1. Paint or enamel applied without pre-treatment.

2. Mill-applied Bonderizing insulates zinc from paint.

3. Full-weight zinc coating.

4. ARMCO Ingot Iron or steel base.

THE AMERICAN ROLLING MILL COMPANY

GALVANIZED PAINTGRIP ARMCO STEEL

District or Central Heating Faces Bright Future

During the war, hundreds of thousands of people have been introduced to the convenience and comfort of district or central heating in housing projects and army or navy bases from coast to coast. As a result, new district heating projects will find a receptive public.

Obsolescence of existing district or central heating systems created by war has resulted in a big backlog for materials, equipment and service.

ALL THIS WILL RESULT IN A BIG DEMAND for ADSCO-BANNON TILE CONDUIT

Made of vitrified clay tile, insulated with "Fiberglas" insulation, it is a combination that can't be topped for permanency or efficiency. Split-tile construction makes it easy to install a group of pipes. Can be furnished for several combinations of pipe in the same conduit thereby reducing cost. Write for Bulletin Number 35-67HP.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA N. Y.
Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

tain specified uses such as solder for joining purposes, paint, and certain processing uses.

Changes have been made in the equipment list (Appendix II). A new paragraph has been added specifying what equipment may be bought with the rating assigned. This provision states that ratings assigned on authorizations issued on or after February 17, 1945, may not be used to get furniture controlled by orders L-13-b, L-260-a, or L-49. In addition the equipment lists have been amended to bring them up to date with other orders. Equipment that is fired by oil or by natural gas must now be specifically listed on the WPB-617 application form.

Natural Gas Pipe Line

Edward Falck, director of the War Production Board office of war utilities, announced February 7 that top priority rating has been given a $9,000,000 natural gas pipe line project to increase deliveries of gas from Oklahoma and Texas into the Ohio-Michigan area by 50,000,000 cu ft daily by next winter.

Copper, Steel, Aluminum Situation Tight

Production difficulties, manpower shortages, and increasing military demands for copper, steel, and aluminum have resulted in a tighter controlled materials situation for the second quarter of 1945 than at any time during the last several quarters, with the result that some war procurement agency production programs may have to be modified, the WPB said March 1.

Steel allocations for the second quarter are below requirements for all claimant agencies—even after re-

QUALITY always wins! MARTOCELLO Products are fully DEPENDABLE

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost.

It will pay you to consult us. WRITE or WIRE for further information.

Jos. A. Martocello & Co. 229-231 NORTH 13th STREET PHILADELPHIA 7, PA.
"Serving the Ice Industry Since 1916" "There is no Substitute for MARTOCELLO QUALITY"

Factory Rebuilt CURTIS
REFRIGERATION COMPRESSORS
Available for Emergencies

★ Many refrigeration suppliers and dealers are experiencing difficulty in furnishing satisfactory repairs for refrigeration compressors now in service. This is due to limitation orders on new equipment, a serious shortage of manpower, and other conditions beyond their control.

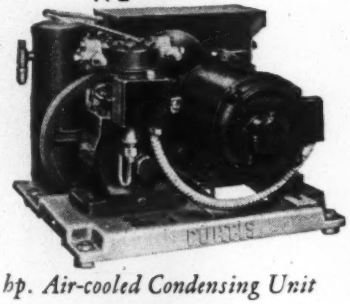
To keep essential Curtis refrigeration on the job while new equipment is restricted for the duration, Curtis reminds you FACTORY REBUILT REFRIGERATION COMPRESSORS are available on an EXCHANGE basis. These compressors are sold in exchange for Curtis compressors needing repairs and are fully guaranteed.

By utilizing this Curtis exchange plan, you can secure a factory-rebuilt and guaranteed Curtis compressor, which will give you long, dependable, and efficient service.

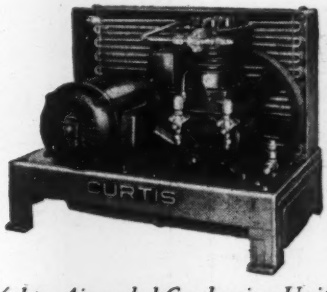
This is but another example of how, despite shortages and limitations, Curtis is making every effort to be of the greatest possible service to dealers and users of Curtis equipment.

Today, Curtis' war job is building more and more Curtis products for our Armed Forces and Essential Industries. This wartime experience, added to that accumulated by Curtis in the past 90 years, assures even finer Curtis equipment for civilian uses after Victory is won.

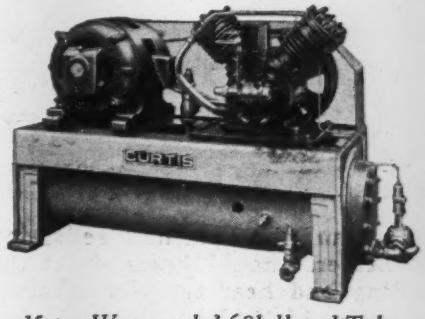
★ ★ ★ ***Conserve Metals — Buy War Bonds*** ★ ★ ★



½ hp. Air-cooled Condensing Unit



1½ hp. Air-cooled Condensing Unit



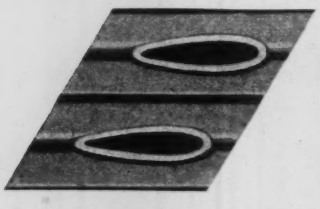
15-ton Water-cooled (Shell and Tube Type) Condensing Unit

CURTIS REFRIGERATION AIR CONDITIONING AND COMMERCIAL

CURTIS REFRIGERATING MACHINE DIVISION *of Curtis Manufacturing Company*
1950 Kienlen Avenue, St. Louis 20, Missouri

Announcing Series 15

UNIT HEATERS



with *Streamline* COPPER TUBES AND FINS

Every man who specifies, sells, installs and uses unit heaters should know about the combined air handling and heat transfer efficiency of Fedders new Series 15 Models.

In addition, they provide extreme ruggedness resulting from advanced wartime metal brazing and fabricating skills.

Send for new Catalog 15C-1 just off the press.

FEDDERS

BUFFALO 7, N. Y.

view and adjustment by WPB. Drastic reductions have been made in less essential nonmilitary and export allotments and steps are being taken for temporary curtailment of steel flows for maintenance, repair, and operating supplies. Despite these measures, it will be impossible to meet the full screened (reviewed and adjusted by WPB) steel requirements of the military services without substantial increases in production, which WPB is trying to effect at the present time.

Copper and aluminum requirements for the military also are rising and can be met only if additional manpower is found for the non-ferrous metal industries, WPB said.

Of all the controlled materials, the carbon steel supply is most out of balance with demands of claimant agencies. Copper has continued to be tight, and for the first time in several quarters, alloy steel and aluminum have presented difficult problems, according to WPB.

Furnace Volume and Heat Release

As a matter of information and reference, the subcommittee on technical manual of the Stoker Manufacturers Association's engineering and research committee has prepared two tables—one on furnace volume vs. heat release and the other on the maximum combustion rate and heat release—taking into account the various controlling factors.

These tables are not official recommendations of the association. The data have been compiled merely for information and reference purposes and are furnished because of many requests from stoker manufacturers, fuel and consulting engineers, etc.

The General Says

ATTENTION

Write today for the complete information which General Blower Co. has prepared for you regarding

GENERAL MULTIBLADE EXHAUSTERS

Ask for Portfolio SC-101—H.P.A.

GENERAL BLOWER COMPANY

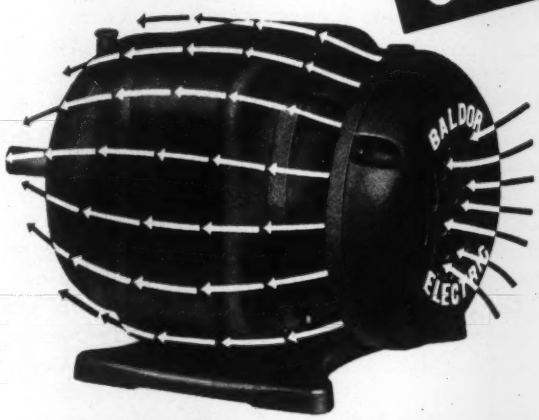
Producers of Air Moving Equipment

401 North Peoria St. Chicago 22, Illinois

THE MOTOR for MANY APPLICATIONS

It's the **BALDOR** *Streamcooled*

ALL-PURPOSE MOTOR



lines indicate air travel over ENTIRE EXTERIOR of Baldor Streamcooled Motor.

This post-war engineered BALDOR Motor will simplify your Designing, Purchasing, Production and Inventory. Check its many features:

1. Totally enclosed.
2. Drip-proof; splash-proof; grit-proof; lint-proof.
3. Horizontal, vertical and side wall mounting.
4. Removable base.
5. End plates interchangeable for face mounting.
6. Standard NEMA dimensions.

BALDOR ELECTRIC COMPANY, St. Louis 10, Mo.

District Offices in Principal Cities

PLAN YOUR POST-WAR MOTOR REQUIREMENTS ***Now.*** Get the Latest BALDOR Bulletins

For **STOKERS**

The CROWN Unbreakable Coal Feed Screw

NOW AVAILABLE for Prompt Delivery

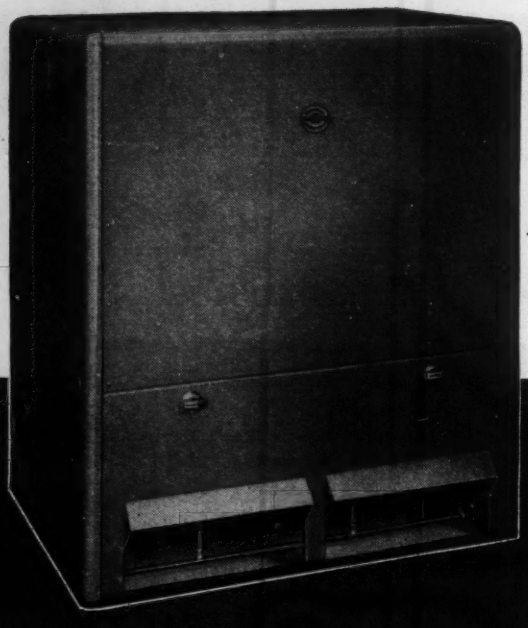
WELDED All-Steel Worm—All Sizes—All Pitches

For replacement or production needs, Crown is now able to offer for prompt delivery its all-steel Coal Feed Screw. Available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. For both domestic and industrial stokers, the Crown Coal Feed Screw insures longer and continuous operation because it is all-steel and because it is machined so smoothly that wear is reduced to a minimum. This smooth surface is your assurance, too, that coal will flow freely and easily through the flights. Prompt delivery is possible because production requires less time on Crown's automatic machines and because the steel used in Crown's Coal Feed Screw while critical, is more easily procured.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1202 Tyler St., N. E. *Since 1878* **Minneapolis, Minn.**



Handle the larger gas boiler jobs successfully — with the new Mueller Type 20 Climatrol

An established leader . . . now restyled for better appearance, redesigned for better performance . . .

Already "tops" in reputation for dependable, economical performance, this Mueller gas boiler is now offered in a new series with many new features, including an entirely new burner design which is extremely quiet in operation. . . . Type 20 (illustrated) is suitable for larger residences, apartments, stores, commercial and industrial buildings, etc. It may be set in batteries to provide large capacity. Types 10 and 11 in this new series are suitable for residences and smaller commercial installations. . . . Mueller has been building heating equipment to quality standards for 88 years and was one of the first in the field with gas-designed equipment. Mueller quality makes installation easier and assures satisfactory service. Write for bulletins. . . . *L. J. Mueller Furnace Co., 2007 West Oklahoma Avenue, Milwaukee 7, Wisconsin.*

Type 20

Gas burner manifold and safety controls enclosed.

New wide range of sizes. Control equipment and trim interchangeable for either right-hand or left-hand end installation.

Type 10 — Type 11

Type 10 has all controls and the backdraft diverter enclosed within the boiler jacket.

Type 11 has the diverter enclosed within the jacket, with controls exposed.

E-15

MUELLER Climatrol
REG. U. S. PAT. OFF.
GAS BOILERS AND GAS-FIRED UNIT HEATERS

NEW BOOKS & REPORTS

Technical Manual on Stokers

"Greater than the separate products of any individual member of the Stoker Manufacturers' Association is the service these manufacturers represent collectively," states the first sentence of the foreword in the new SMA Technical Manual on Industry Standards, Recommended Practices, and Technical Information, which the association, nation-wide organization of manufacturers of mechanical and automatic coal burning equipment, is releasing for distribution to the stoker trade and others interested in the selection and application of mechanical underfeed stoker equipment, Marc G. Bluth, executive secretary, announced last month.

In keeping with the thought expressed in the foreword, the association, through its engineering and research committee, has prepared this material on the selection of stokers and boilers and furnaces for stoker firing together with other pertinent and up-to-date information, for the guidance, reference, and practical use of architects, consulting engineers, builders, mechanical engineers, fuel and combustion engineers, schools and universities, heating contractors, boiler and furnace manufacturers and installers, and stoker dealers, distributors, installers, service men, and stoker manufacturers and their own individual staffs.

Here within the covers of one book, Mr. Bluth said, is

EFFICIENT ECONOMICAL

De Luxe type WK Pressure Actuated Water Regulating Valves for Freon, Sulphur or Methyl, are pilot operated, modulating. Standard adjustable opening range from 50 to 150 lbs. Factory set to open at 90 pounds. Precision engineering and individual testing for low cost, satisfactory performance. Available in sizes of ¾ to 2 inches FPT. Simple adjustment—easily serviced.

Other sizes and types are also available.

Electrimatic
2100 INDIANA AVE. CHICAGO 16, ILL.

Engineered for CONTROLLED TEMPERATURES

VULCAN continuous line radiation has set new standards in heat distribution, simplified installation, compressed greater heating surface into compact light weight units . . . one length of VULCAN being equal in heat output to eight 1½" pipes of the same length. Most of the heat is given off by convection, the air circulating gently but adequately throughout the heated space. Temperature varies little vertically . . . is uniform horizontally, drafts are eliminated.

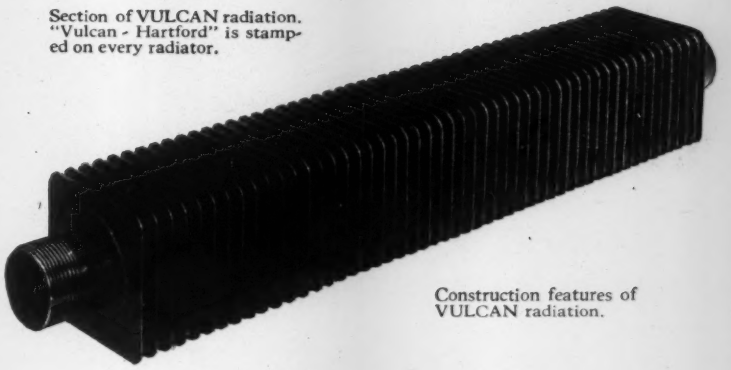
CONSTRUCTED TO LAST

VULCAN uses heavy wall seamless steel pipe on which steel fins are permanently fastened by a special process which requires no solder. Fins are offset for greater rigidity. Sections come cut to length, ends threaded or chamfered. Few fittings are needed. VULCAN radiation will give many years of constant service with no maintenance.

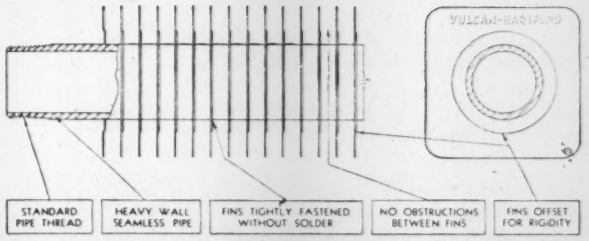
Catalog on request.

Representatives in principal cities.

Section of VULCAN radiation. "Vulcan - Hartford" is stamped on every radiator.



Construction features of VULCAN radiation.



THE VULCAN RADIATOR CO.

26 FRANCIS AVENUE 6, HARTFORD, CONN.

Radiator Manufacturers For Almost Two Decades

"Killer" CALL BACK

When you use a faulty tee, ell or flange you are extending a special invitation to "KILLER" Call Back, the waster of your time . . . the despoiler of your profits.

In fittings, no other grade but the best yields a profit. "K's" are high grade, thoroughly inspected fittings and when properly installed there are extremely few call backs.

The "K" line is complete . . . every type and size you will require.

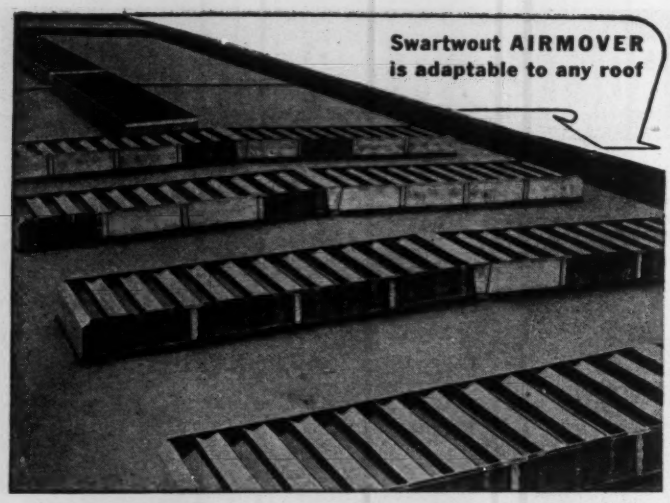
COMPLETE LINE. CATALOG ON REQUEST.

Standard and extra heavy cast iron screwed fittings.
Standard flanged fittings.
Standard and extra heavy companion flanges.
Drainage fittings.

"K" fittings carried in stock at Malleable Iron Fittings Company, Branford, Conn.; M. I. F. stocks at Kuhns Brothers Co., Dayton, Ohio.

KUHNS BROTHERS CO.

DAYTON 7, OHIO



Modern "Open Roof" Ventilation with Swartwout *AIRMOVER*

Solves toughest large scale ventilation problems

● Nowadays no successful employer denies the extreme importance of ventilation in efficient industrial operations. More and better production is the profitable result when working areas are cleared of excessive heat, smoke and fumes—a result easy to get, and economically, with Swartwout AIRMOVER "open roof" method of natural ventilation. It is in everyday use on many mill and factory buildings, giving unusually successful results.

Built in quickly erected units only 32 inches high, AIRMOVER is installed in any quantity, up to practically complete roof coverage. Any roof, even on old buildings, can carry an AIRMOVER installation, without expensive alterations. Custom-built equipment is supplied where necessary. Send sketches of your buildings for suggestions of improving your factory ventilation.

The Swartwout Company
18511 Euclid Ave., Cleveland 12, Ohio

Can be as wide as your roof—but never more than 32" high.

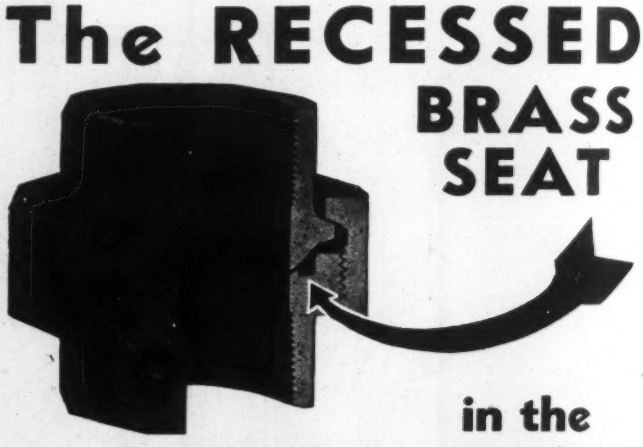
Specialists in Air Movement
by *Natural* Methods

brought together the results of years of practical experience and technical practices and recommendations of the stoker industry's leading engineers and executives, together with a compilation of the industry's basic codes, standards, and recommended practices.

The manual is composed of eight separate sections, as follows: 1. Glossary of terms—defining the phrases and terminology used in the manual; 2. Selection factors—the major selection factors to be considered in the selection of stoker equipment and boilers or furnaces for stoker firing; 3. Condensed table—a condensation in table form of all the various selection factors; 4. Standard codes and recommendations—all of the standard codes and recommended practices established during the past several years by the Stoker Manufacturers' Association; 5. Chimney data—tables incorporating recognized information on sizes and heights of chimneys and smokestacks reprinted from current engineering guides; 6. Stoker nomenclature—for the first time in this section are published and illustrated the standard names of different major component parts of underfeed stokers; 7. Coal data—general information on bituminous and anthracite coals, such as sizing and analyses, and including a map of the coal fields of the United States; and 8. Miscellaneous—descriptive sheets showing care and operation of commercial and industrial underfeed stokers for both Bituminous and Anthracite, and complete tables showing areas in square feet of rectangles and areas of circles.

The manual contains 60 pages, 8½x11, printed, paper-bound, and the inside pages punched for filing in loose-leaf manuals and reference books. Copies of the man-

The RECESSED BRASS SEAT



in the

JEFFERSON UNION

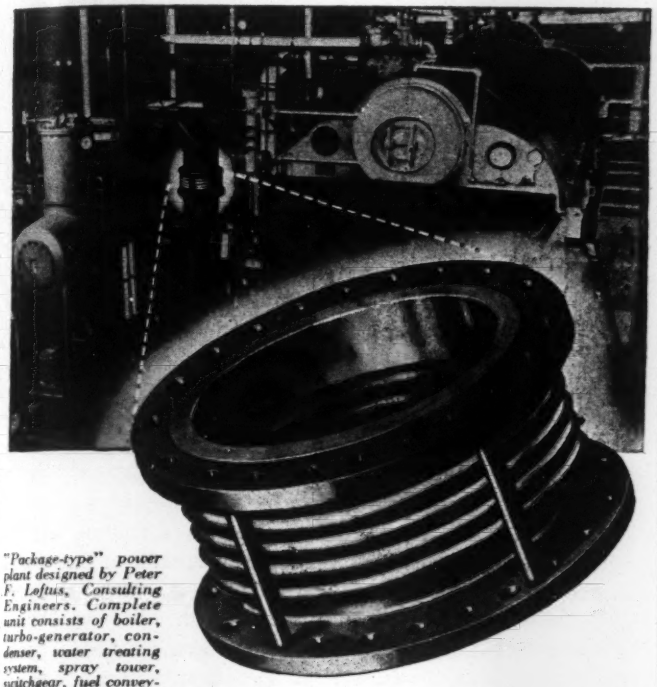
is cut from seamless drawn tubing —free from all casting defects— sound and uniform always!

JEFFERSON UNION CO.

601 West 26th Street, New York 1, N. Y.

Factories at
Lexington 73, Mass. Lockport, N. Y.

"PACKAGE-TYPE" POWER PLANTS USE ZALLEA EXPANSION JOINTS



"Package-type" power plant designed by Peter F. Loftus, Consulting Engineers. Complete unit consists of boiler, turbo-generator, condenser, water treating system, spray tower, switchgear, fuel conveying system, all auxiliaries. Generator capacity—500 kw.

• The "package-type" portable power plant was born of the needs of war—and of postwar rehabilitation. They are so designed that they can be "packaged" and sent overland and overseas. They can be readily moved from one location to another to meet critical demands for power in military and industrial operations.

In service such as this, each and every functional unit and auxiliary must be selected on the basis of ability to operate continuously with little maintenance or attention. It is, we believe, significant that Zallea stainless steel expansion joints were chosen to absorb lateral motion in the 20" vapor line between the turbine exhaust and condenser.

Zallea Standard Expansion Joints can be supplied in sizes from 4" to 30" diameter, of many types of stainless steel as well as copper, for pressures from vacuum to 300 psi, and temperatures from sub-zero to 1800° F.

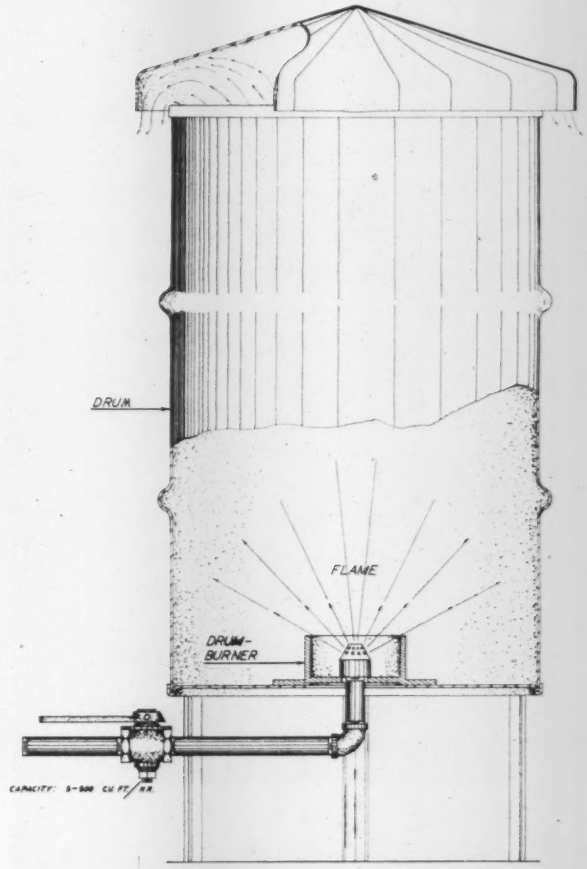
"Code-Craft"...

ZALLEA BROTHERS & JOHNSON

...EQUIPMENT FOR THE PROCESS INDUSTRIES

816 LOCUST ST. • WILMINGTON 99 • DEL.

John Zink



DRUM GAS BURNER

Solves Warehouse Heating!

A John Zink Stove Burner fitted into an oil drum, a piece of casing or a piece of old pipe, makes a very efficient heater for warehouses, store rooms, machine shops, garages and work shops.

Sells for $5.50 f.o.b. Tulsa, Okla.

Burner Only

Shipping weight 10 lbs.

Can be used on any type of gas at any pressure. Furnished with Burner Head suitable for ⅜" or ¾" Gas Connection—5 to 500 cu. ft./hr. capacity—Trouble-free operation—No service—No adjustment needed—Can't get out of order—Lasts for years—Can be used either with or without brick baffles.

•

John Zink Company

4401 South Peoria

TULSA, OKLAHOMA

New York - Los Angeles - Detroit - San Francisco - St. Louis

"COMMERCIAL"

VENTURI TYPE FAN HOUSINGS

A new line of 12 sizes are now available without die charges.

The venturi section and support plate are formed in one piece — without welds or folds.

This is the fan housing that will maintain full efficiency of the fan.

WRITE FOR PARTICULARS

THE COMMERCIAL SHEARING & STAMPING CO.
Youngstown, Ohio

ual are available from the Stoker Manufacturers' Association, 307 N. Michigan Ave., Chicago 1. The price for a single copy or up to 10 copies is $1.00 per copy; the price for 10 to 50 copies is 85c each, and for over 50 the price is 75c each. The association, however, will furnish single copies free to registered architects, consulting engineers, builders, and other professional men engaged in engineering and design work on homes, buildings, boilers, furnaces, and equipment related to or allied with automatic and mechanical stokers. Such requests must be in writing on the letterhead or stationery of the individual or firm.

Simultaneously with the announcement of the release of this manual, Mr. Bluth stated that a four-page folder containing a consolidated table of the factors for the selection of stoker equipment as reprinted from the handbook would also be available in separate form.

This table, together with explanatory notes, contains essential and basic engineering and technical data covering load carrying capacities of various size stokers ranging from 15 to 1200 lb per hr of coal and the association's recommendations as to setting heights, boiler and furnace minimum widths and lengths, together with condensed data on chimney sizes.

While this "consolidated table" is merely a reprint from the technical manual, it is expected that it will be very readily accepted in the trade because of the form in which the data have been prepared. It is a four-page folder, 8½x11, and punched for looseleaf forms or reference books. Single copies are available from the Stoker Manufacturers' Association, at 5c per copy. Lower prices are obtainable for copies in quantity lots.

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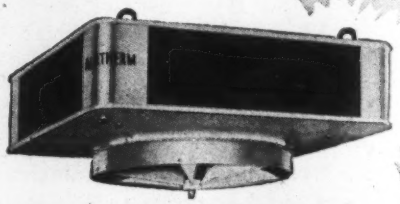

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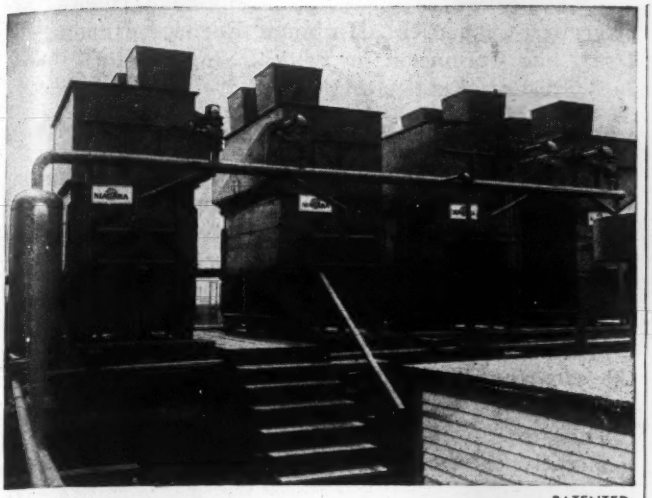

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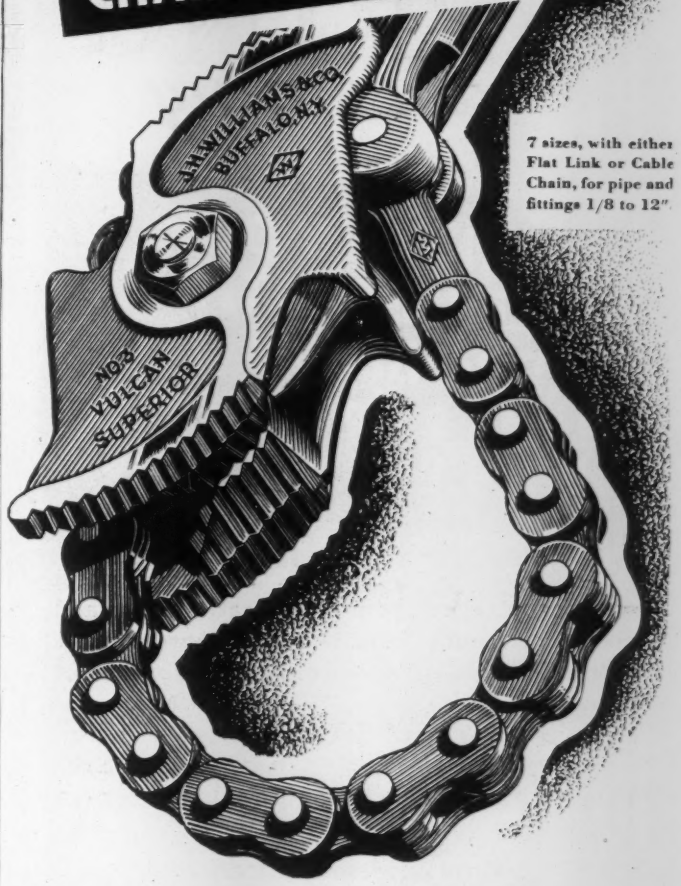

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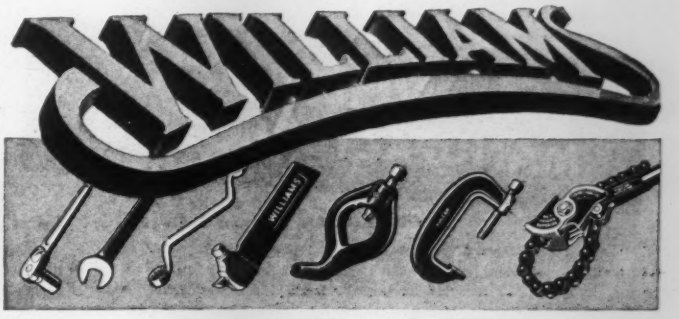

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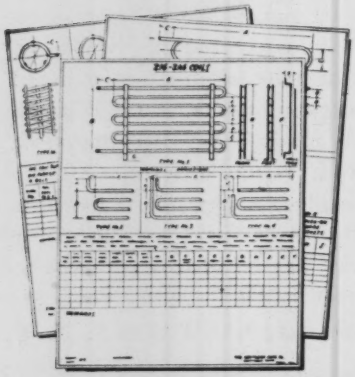

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The publication is entitled Consolidated Table—Load Carrying Capacities; Minimum Furnace Dimensions; Draft and Chimneys for Typical Single Retort Underfeed Stokers; Explanatory Notes.

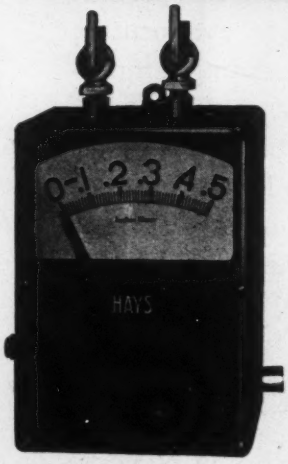
Vapor Transmission of Insulating Board

Vapor Transmission Analysis of Structural Insulating Board, bulletin No. 22 of the University of Minnesota engineering experiment station, by Frank B. Rowley and C. E. Lund, professor and associate professor respectively, of mechanical engineering, has just been published. This 71 page booklet has been designed to give builders and contractors some practical guide in the construction of insulated buildings where the condensation of moisture in walls is apt to be a problem.

This bulletin covers the results of the first part of a cooperative research program between the Insulation Board Institute and the University of Minnesota engineering experiment station, the purpose of which was to study the vapor permeability properties of structural insulating board and of the walls and structures in which these boards are often used. It contains the final results of a series of tests on insulation board material, both individually and incorporated into test walls. A later bulletin will discuss the results of investigations made during the second part of the program—an analysis of complete structures containing the various walls under adverse moisture conditions.

A discussion of the theory of vapor transfer through materials is presented in this publication. A comparison of this theory with the theory of heat flow through materials, a discussion of the effects of temperature and

DIRTY FILTERS can ruin the efficiency of the best air-conditioning system made....



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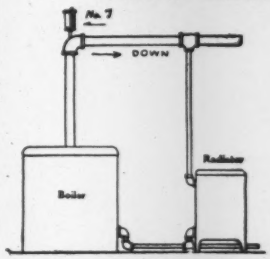

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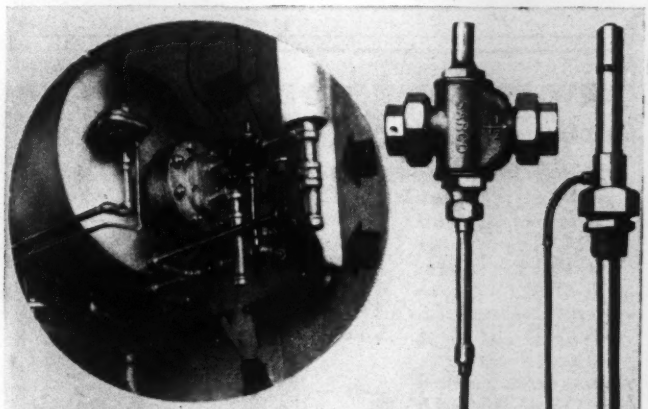

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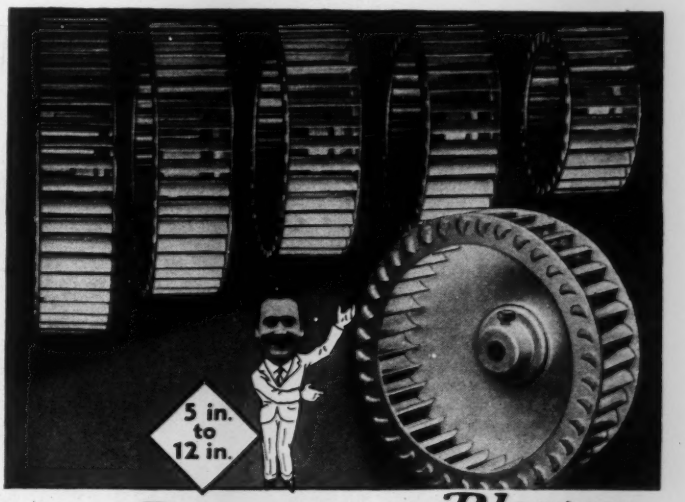

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of the physical properties of materials on permeability, suggestions as to terminology and a discussion of the special rating apparatus by means of which the theory was checked on individual materials and numerous combinations of them in complete wall sections, are also presented.

Various types of paint and surface finishes used to reduce vapor permeability were studied to determine the practicability of applying them. A list of these finishes and their relative vapor resisting properties is given in the bulletin.

Building location has been studied and a line has been suggested, dividing the United States into two parts, one in which vapor barriers are desirable and recommended and the other in which barriers may be omitted with reasonable safety.

Copies may be obtained from the University of Minnesota, Minneapolis, for 40c.

Thermal Environment and Radiant Heating

In bulletin No. 33 of the Cornell University engineering experiment station—entitled Radiant Heating and Cooling, Part II—C. O. Mackey discusses the variables which affect the rate of heat loss from an individual in his thermal environment. Copies are available from the College of Engineering, Cornell University, Ithaca, N. Y., for 40c.

Following is the author's summary of results of the study:

1. Equations are developed for the rate of heat loss from the human body by convection and radiation.
2. Mean radiant temperature is precisely defined for

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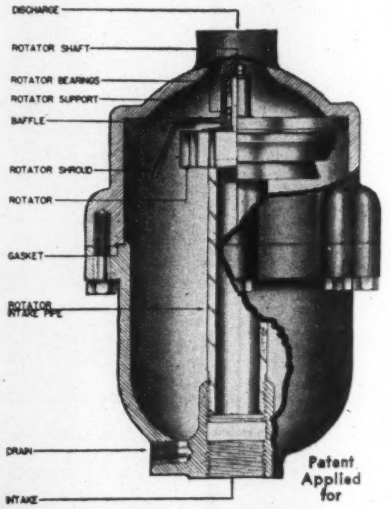

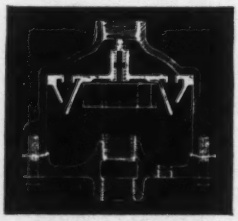

Drawing shows turbo-rotor, shroud and baffles. The design of the baffles precludes the possibility of capillary action of entrainments resulting from high velocity.

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a "black" enclosure, and the use of the globe thermometer in the measurement of mean radiant temperature is explained.

3. Operative temperature is defined in terms of air temperature, air movement, and mean radiant temperature. In thermal environments, where operative temperature is kept the same, there will be the same rate of heat loss by combined radiation and convection from the human body with substantially the same average temperature of the skin and clothing. A *physical* environment is thus defined. A method of direct measurement and control of operative temperature in "still" air is developed.

4. The use of the method of heat balances in the study of thermal environment is explained, and illustrative numerical examples are solved.

5. For one room of assumed proportions and with completely absorbing (non-reflecting) surfaces, the thermal environments created by four different methods of heating are compared. These methods include convective heating and panel warming with the ceiling, floor, or interior wall as a heated panel. In each case, the operative temperature at the center of the room is held the same, and the required rates of heat supply are compared as well as the uniformity of operative temperature at different stations in the room. For the assumed room, the required rate of heat supply in the case of panel warming with the ceiling as the panel is found to be the smallest and is 2.8 per cent lower than in the case of convective heating. The environment is found to be the most uniform with the ceiling as a panel and least uniform with an interior wall as a panel; the

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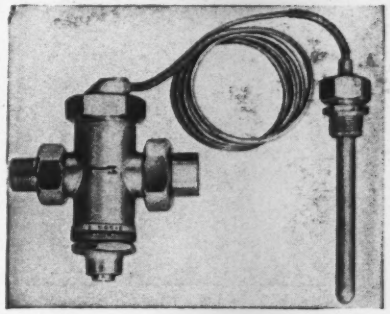

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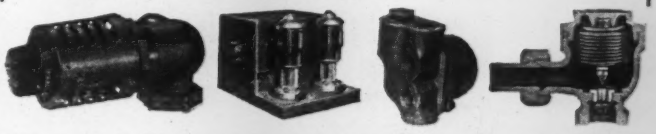

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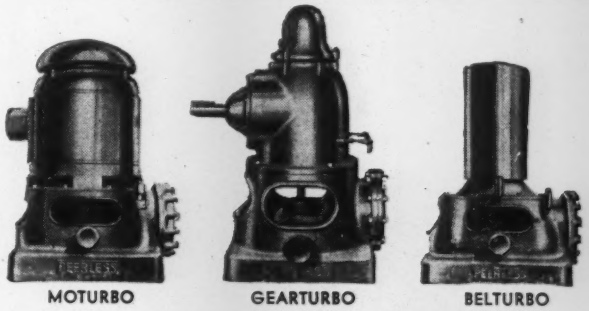

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ceiling panel is found to give the environment with the greatest positive difference between mean radiant and air temperatures.

6. Two methods of heating a room with completely absorbing surfaces, two exposed walls, and exposed window are compared. In one case, the room is assumed to be heated with the ceiling as the warmed panel; in the other case, convective heating of the same room is assumed. In each case, the operative temperature at the center of the room is the same. The method of heat balances indicates that the required rate of heat supply is 1.8 per cent lower with panel warming than with convective heating.

7. A model room having the same proportions as the prototype room may be used to investigate a *physical* environment through the use of operative temperature. To insure the same film coefficients of convective heat transfer in the model room as in the prototype, no dimension of the model room should be less than 2 ft. If the rate of air change in the model room is made n times as great as that expected in the prototype, where n is the scale ratio, the method of heat balances indicates that the various surface temperatures and the required rate of heat supply per square foot of panel or wall area in the model room will be the same as in the prototype. To investigate the *physiological* environment, human subjects must be used in a room constructed to full scale.

One of the assumptions made in the method of heat balances is that the temperature of each separate room surface is uniform over the entire surface. This is not exactly true, and by comparing the test results on the

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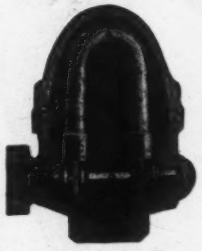

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model room with the results predicted by the theory of heat balances, the effects of this assumption may be determined.

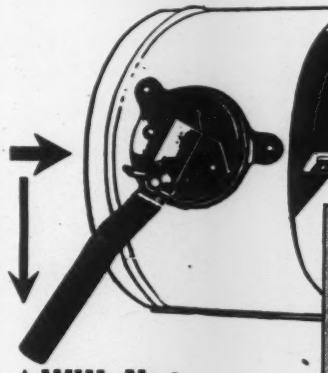
8. The methods used in this study may be employed to investigate the thermal environments produced with other methods of radiant heating and cooling. In particular it seems desirable to explore the possibility of using high temperature strips or cylindrical heating panels of small diameter. Also, the use of reflective surfaces in the room should be studied as a means of creating a thermal environment wherein there is a large difference between the mean radiant and air temperatures. Apparently, the use of highly reflective room surfaces is necessary if any considerable economy is to be realized from radiant heating.

Handbook for Pipe Fitters and Welders

Thomas W. Frankland, instructor in the steamfitting department of the Washburne Trade School, Chicago, and a member of the Pipe Fitters Association, Local Union 597 U.A., is the author of a 152 page, 5½ by 3¾ in., handbook for pipe fitters and pipe welders in which he has compiled basic information "which will enable the pipe fitter to solve the difficult problems which he encounters in his work."

There are sections on basic trade mathematics, pipe fitting calculation, pipe welding layout, and 43 pages of reference tables. There are numerous informative and excellent sketches, and the book—of handy pocket size—is clearly printed.

The publisher is the Bruce Publishing Co., 540 N. Milwaukee St., Milwaukee 1, and the price is $1.25.



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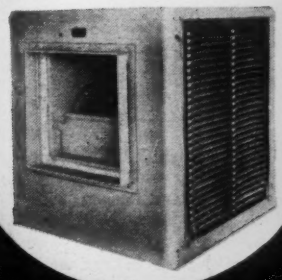

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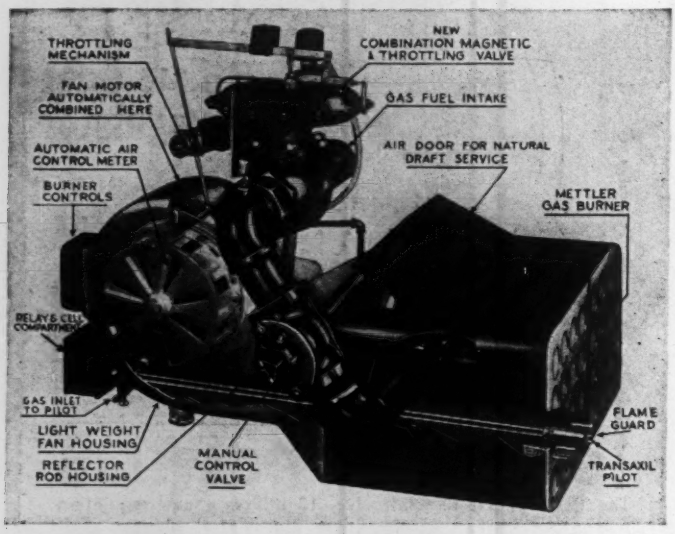

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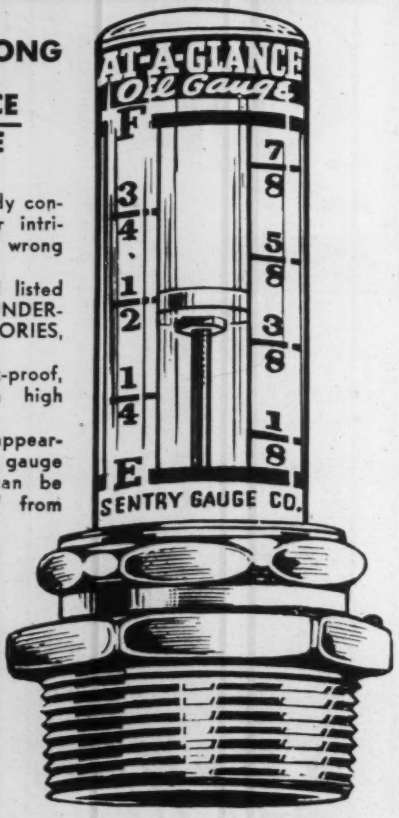

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Predicts Use of Heat Pump

A unique method of heating by extracting heat from the outdoor air (the "heat pump"), even when the temperature outside is below freezing, has definite commercial possibility in the near future and offers fuel economy and efficiency far surpassing present heating systems, according to G. K. Marshall, General Electric air conditioning engineer, who said that several installations were made before the war and are still operating satisfactorily. He spoke before the Lehigh Valley section of the American Institute of Electrical Engineers.

Mr. Marshall said that at about 52 F outdoor temperature, it will provide four times as much heat as is available in the electricity consumed. Even allowing 15 per cent for electrical transmission losses, it will deliver at the 52 F outdoor condition 116 per cent of the heat that was in the fuel burned for supplying energy.

In regard to cost of operation, Mr. Marshall said, "Using power at 1 cent per kwhr, the heat pump would have the same operating cost as coal at $14 per ton, oil at 10c per gal, manufactured gas at 40c per 1000 cu ft or natural gas at 80c per 1000 cu ft. This is approximately the picture as it exists today with a heat pump constructed with general purpose refrigeration equipment in a climate such as Pittsburgh and drawing its evaporator heat from the outdoor air. But it can be improved by further development of the equipment or by finding a higher temperature source of heat than outdoor air."

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MEETINGS & CONVENTIONS

War Production Conference

The third annual war production conference sponsored by the Chicago Technical Societies Council is to be held Thursday, March 29, at the Stevens Hotel, Chicago, government approval having been obtained. A panel session on heating and air conditioning, sponsored by the Illinois chapter of the American Society of Heating and Ventilating Engineers, is on the program. Publication office of the CTSC is at 75 E. Wacker Dr., Chicago 1, Ill.

ASRE's Connecticut Valley Section

The next meeting of the newly formed Connecticut Valley section of the American Society of Refrigerating Engineers is scheduled for March 15 in Hartford, with J. C. Yantis, of Wolverine Tube Co., speaking on the manufacture and fabrication of copper tubing. The secretary of the section is John K. Campbell, Bush Mfg. Co., Hartford, Conn.

District Heating Association

At the meeting of the executive committee of the National District Heating Association held February 28, the annual meeting of the association, formerly scheduled for June 13 and 14, was cancelled. The NDHA plans to continue all committee work. The papers will

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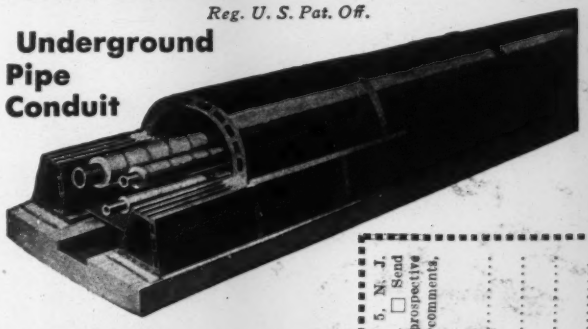

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